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I N T E N D E D C H I E F L Y F O R T H E
U S E O F H U S B A N D M E N.

BY JOHN MILLS, ESQ. F.R.S.
Honorary Member of the Dublin Society, of the Royal Societies of
Agriculture of Paris and Rouen, of the Oeconomical Society of
Berne, and of the Palatine Academy of Sciences and Belles-Lettres,

T H E S E C O N D E D I T I O N , I M P R O V E D .

L O N D O N :
P R I N T E D F O R S . H O O P E R , L U D G A T E - S T R E E T .
M D C C L X X I I I .



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T O

THE REVEREND
GEORGE TILSON, A. M.
OF RICHMOND, IN SURRY,

A GENTLEMAN SKILLED IN
BOTANY,

A LOVER AND JUDICIOUS ENCOURAGER OF
AGRICULTURE,

AND A DISTINGUISHED FRIEND TO
THE LAUDABLE PURSUITS OF
ALL MANKIND;

THIS SECOND EDITION OF THE FOLLOWING ESSAY
IS RESPECTFULLY INSCRIBED,

BY

HIS MUCH OBLIGED, AND

MOST OBEDIENT SERVANT,

LONDON, October 12, 1772.

JOHN MILLS.

In one volume 8vo. price bound 5s. sewed 4s.

ESSAYS
MORAL, PHILOSOPHICAL,
AND
POLITICAL,
On the following Subjects;

VIZ.

- I. ON PHILOSOPHY AND PHILOSOPHERS.
- II. ON PROJECTS.
- III. ON LOVE AND JEALOUSY.
- IV. ON COMMERCE AND LUXURY.
- V. ON AGRICULTURE.

By the AUTHOR of this ESSAY.

N. B. The Authors of the Critical Review for January, 1772, conclude their Account of this Work, as follows: viz. "We may say with Justice of the Whole, that they discover the Author to be a Person of Learning, Taste, and Philosophical Sentiment; and the Third Essay is particularly ingenious, and contains many just observations on Modern Manners."



P R E F A C E.

THINKING it would be wrong in me to be the first publisher of another person's discoveries, especially when there was reason to presume that the discoverer himself might be induced to communicate them to the public; this essay has lain by for some years, in expectation that my highly respected friend, Dr. Benjamin Franklin, would one day favour the world with what he had before imparted to me concerning the affinity between lightening and the electrical fire, and the means of preserving houses from the dangers of the former. That scruple being now removed, by the Doctor's late publication of his "Experiments and Observations on Electricity," with the addition of his "Letters and Papers on various philosophical subjects," I at length give the following sheets (originally intended as a part of

my Treatise on Husbandry) in hopes that they may be of some service to that essentially necessary, but too much neglected class of mankind, husbandmen.

The advantages which may arise from a fore-knowledge of the changes of the weather are so frequently pointed out in the following sheets, that I cannot well do more here, than repeat my advice to farmers, to turn their attention to observations of this kind more than they have generally done, with a probable expectation of their reaping *a crop* of useful knowledge: for though ill-founded predictions have cast a discredit upon the study of, or attention to, the changes of the weather; yet it is hard to say to what degree of perfection men who make the works of nature their study may arrive, both in tracing the causes of the alterations of the weather, and in fore-seeing the successions of its changes.---The fisherman, who has been long practised in his business, seldom unfurls his sails when a storm is near, owing to his constant observation of the sky: and were farmers equally attentive, and had once acquired as

much judgment in this matter, they would be as seldom overtaken by unlooked for changes.

They must not however at all times look so high, as to neglect what passes around them on the surface of the earth. The beginning vegetation of plants, especially of the natives of each country, is a kalendar well worthy observation, as a directory of the seasons proper for certain works in the spring : nor should the accidents which happen to even the least useful plants be neglected, because they may afford hints of what should be done to prevent the like evils in plants of greater utility.

Linnæus and his disciples have given excellent instructions on this head. One of them in particular, Mr. Harold Barck, in his very ingenious Dissertation on the Foliation of Trees, presented in 1753 to that great, and hitherto unrivalled school of natural history, the university of Upsal, under the presidency of the excellent Linnæus, tells us it was then the fourth year since that illustrious botanist exhorted his countrymen to observe with all care and diligence, at

what time each tree expands it's buds, and unfolds it's leaves ; imagining, and not without good reason, that his country, and the same is equally applicable to every other, would, some time or other, reap some new, and perhaps unexpected benefit, from observations of this kind made in different places.

As one of the apparent advantages, he advises the prudent husbandman to watch with the greatest care the proper time for sowing ; because this, with the divine assistance, produces plenty of provision, and lays the foundation of the public welfare of the state, and of the private happiness of the people. The ignorant farmer, continues he, tenacious of the ways and customs of his ancestors, fixes his sowing-season generally to a month, and sometimes to a particular day, without considering whether the earth be prepared to receive the seed : from whence it frequently happens, that the fields do not return what might be expected, and that what the sower sows with sweat, the reaper reaps with sorrow. The wise economist should therefore fix certain signs

whereby to judge of the proper time for sowing. We look up to the stars, and, without reason, suppose that the changes on earth will answer to the heavenly bodies; entirely neglecting the things which grow around us. We see trees open their buds, and expand their leaves; from whence we conclude that spring approaches, and experience supports us in the conclusion: but no body has yet been able to shew what trees Providence intended should be our kalendar, so that we might know on what day the countryman ought to sow his grain. No one can deny but that the same power which brings forth the leaves of trees, will also make the grain vegetate; nor can any one justly assert that a premature sowing will always, and every where, accelerate a ripe harvest. Perhaps therefore we cannot promise ourselves a happy success by any means so likely, as by taking our rule for sowing from the leafing of trees. We must, for this end, observe in what order every tree puts forth it's leaves, according to it's species, the heat of the atmosphere, and the quality of the

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foil. Afterwards, by comparing together the observations of several years, it will not be difficult to determine, from the foliation of trees, if not certainly, at least probably, the time when annual plants ought to be sown. It will be necessary likewise to remark what sowings made in different parts of the spring produce the best crops, in order that by comparing these with the leafing of trees, it may appear which is the most proper time for sowing: nor will it be amiss in like manner to note at what times certain plants, especially the most remarkable in every province or country, blow; that it may be known whether the year makes a quicker or slower progress.

Linnæus's methods of carefully observing the foliation of trees, &c. would undoubtedly determine right the proper time for spring-sowing; and Pliny, after mentioning the several constellations by which farmers were guided in his time, instructs the husbandman with regard to autumnal sowing, upon a principle similar to that of our great modern naturalist. " Why,

“ says he, (Lib. xviii. c. 25.) does the
 “ husbandman look up to the stars, of
 “ which he is ignorant, whilst every
 “ hedge and tree point out the season
 “ by the fall of their leaves? This
 “ circumstance will indicate the tem-
 “ perature of the air in every climate,
 “ and shew whether the season be early
 “ or late. This constitutes an univer-
 “ sal rule for the whole world ; because
 “ trees shed their leaves in every coun-
 “ try according to the difference of the
 “ seasons. This gives a general signal
 “ for sowing ; Nature declaring that
 “ she has then covered the earth against
 “ the inclemency of the winter, and
 “ enriched it with this manure.”

Mr. Stillingfleet, who has given us a
 judicious translation of several excellent
 pieces published by sundry disciples of
 the Linnæan school, informs us, that
 he himself was told by a common hus-
 bandmen in Norfolk, that when the
 oak catkins begin to shed their seed, it
 is a proper time to sow barley : “ And
 why,” adds he, very properly, “ may
 “ not some other trees serve to direct
 “ the farmer for the sowing of other

“ seeds ? The prudent gardener never
“ ventures to put his house plants out
“ till the mulberry leaf is of a certain
“ growth.” Hesiod, continues this
gentleman, (Miscellaneous Tracts, p.
147,) began to fix the proper seasons
for plowing, sowing, &c. by the ap-
pearance of birds of passage, or of in-
sects, or by the flowering of plants :
but we have no record of observations
of this kind being made till Linnæus
wrote. Hesiod says, that when the
voice of the crane is heard over-head,
then is the time for plowing ; that if
it should happen to rain three days to-
gether when the cuckow sings, late
sowing will then be as good as early
sowing ; that when snails begin to creep
out of their holes, and climb up plants,
it is time to cease digging about the
vine.

There is a wonderful co-incidence,
which probably takes place in all coun-
tries, between vegetation and the arri-
val of certain birds of passage. Lin-
næus says, that the *wood-anemone* (in
Sweden) blows from the time of the
arrival of the swallow ; and Mr. Stil-

lingfleet finds by a diary which he kept in Norfolk for the year 1755, that the swallow appeared there on the 6th of April, and the *wood-anemone* was in bloom on the 10th of the same month. Linnæus observes, that the *Marsh-marigold* blows when the cuckow sings; and Mr. Stillingfleet finds by his diary that the *Marsh-marigold* was in blossom on the 7th of April, and the cuckow sung the same day.

The methods here hinted at deserve the most serious attention of every lover of his country. A series of observations of these kinds, properly made by intelligent persons, in different parts, and afterward rightly compared and combined, would soon afford almost infallible rules to guide the husbandman in one of the most important parts of agriculture. I cannot too strongly recommend it to the public spirited inhabitants of the British dominions in particular, as a means by which the power and opulence of this happy state cannot fail to be considerably increased, and the felicity of individuals to be consequently confirmed.

The principal points necessary in the making of these observations are, 1st, That they be continued for a due length of time, and the *time* and *place* of observation be particularly specified. 2dly, That they be made on the same *subjects*: and 3dly, That the *soil* and *exposition* be carefully noticed and described, in order to their being duly compared with the field intended to be sown. The necessity of being as exact as possible in this last article, will appear to every one who does but consider, what all know, that the *north-wind*, *shade*, and a *moist soil*, hinder the leafing of trees, as much as a *dry situation* on the *slope* of a hill inclining to the *south* promotes it.--- Another circumstance which would greatly facilitate the application of these observations, is, to take the trees in their progressive order of leafing: for nature is always regular, and the guide would then be sure.

The changes of the weather, and their effects on both the animal and the vegetable kingdom, are likewise an object which has been long pursued by the Royal Academy of Sciences, and

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especially of late years by the justly celebrated M. Duhamel, in his meteorological observations published annually in the Memoirs of that Academy.

The different societies of agriculture instituted in the several foreign nations of Europe, have also taken up this subject: that of Berne in particular has likewise published annually observations of this kind: I shall here subjoin by way of appendix, an abstract of those of the year 1766, as a model worthy of imitation. In this abstract, I say but little of the weather in Swisserland, because the Berne journal of the barometer and thermometer would swell this work too much, and might be thought rather too local; though the reader would be surprized to see the similarity in the motion of the barometer in that country and in this.

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A N
E S S A Y
O N T H E
W E A T H E R.

I N T R O D U C T I O N.

THE many advantages arising to the industrious farmer from a foreknowledge of the changes of the weather, and the example set us by all the antient writers on husbandry, are sufficient inducements for my endeavouring to draw the attention of husbandmen to observations which must be so highly beneficial to them. It might indeed have been expected, that, considering the great improvements which have been made in natural philosophy in the two last centuries, an accurate account of the weather would ere now have been attained: yet the earliest authors who have

treated of husbandry, seem to have established more certain prognostics of the weather peculiar to their climates, than any have done for our's; though it may be presumed that the operations of nature are set in a much clearer light to us, than they could be to them, by means of the many and great discoveries which the moderns have made. Perhaps philosophers have not had opportunities, from their own observations, of laying down any certain rules of the changes of the weather, and either despised or neglected the remarks of illiterate country people. Such, it is supposed, was the shepherd of Banbury, whose *rules to judge of the changes of the weather* are the only observations of this kind that have been adapted to this country; the modern writers on husbandry, who have said any thing of the weather, and even that great restorer of natural knowledge, lord Bacon, having too servilely followed the antients.

Who the shepherd of Banbury was, we know not; nor indeed have we any proof that the rules called his were penned by a real shepherd: both these points are how-



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ever immaterial: their truth is their best voucher. Mr. Claridge, who published them in the year 1744, since which time they are become very scarce, having long been out of print, tells us, that they are grounded on forty years experience, and thus, very rightly, accounts for the presumption in their favour. “ The shepherd, whose
“ sole business is to observe what has a re-
“ ference to the flock under his care, who
“ spends all his days, and many of his nights
“ in the open air, under the wide-spread ca-
“ nopy of heaven, is obliged to take par-
“ ticular notice of the alterations of the
“ weather; and when he comes to take a
“ pleasure in making such observations; it
“ is amazing how great a progress he makes
“ in them, and to how great a certainty he
“ arrives at last, by mere dint of comparing
“ signs and events, and correcting one re-
“ mark by another. Every thing, in time,
“ becomes to him a sort of weather-gage.
“ The sun, the moon, the stars, the clouds,
“ the winds, the mists, the trees, the flowers,
“ the herbs, and almost every animal with

“ which he is acquainted, all these become;
“ to such a person, instruments of real know-
“ ledge.”

I shall occasionally quote such of the shepherd's rules as may tend to strengthen or confirm my reasonings, by facts; and endeavour to explain others of them on the principles of the latest discoveries, which Mr. Claridge was either unacquainted with, or neglected to notice,

But before I begin to speak of the particular prognostics of the weather, and, with them, of the shepherd's rules, it may not be amiss to give a concise and general account of the following articles, thereby to throw the greater light on the rules themselves, as well as on my observations.

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SECTION I.

*Of Clouds, Fog, Rain, Snow, Hail, Thunder and
Lightening.*

THE higher water is raised in the air, the farther it's parts recede from one another. In this case, they will not probably constitute water, but the primary particles or principles of water. When these particles are equally dispersed in the atmosphere, it is transparent: but when they descend again from the upper regions, and occupy smaller spaces, they associate together, or form a moist vapour, and become clouds. The higher therefore water ascends in the air, the more serene and dry the weather will be, and the more free from clouds. The atmosphere is usually heaviest at this time; so that, in reality, as observed by Boerhaave, there is then more water in the atmosphere, than when, by reason of the dryness below, people generally imagine there is least in it. The snow seen on the tops of the highest mountains, shews to how great an height water rises in the atmosphere.

The following seem to be some of the chief causes of the ascent of water and other exhalations into the air.

First; Fire, whether culinary, subterraneous, or of the sun. The subterraneous heat probably arises from the effervescence of different substances under ground, and sometimes from their taking fire. Heat, from whatever cause it arises, renders many particles of water lighter than the lower air; they therefore ascend till they come to air of the same specific gravity, as is justly observed by M. de la Hire, in the Memoirs of the royal Academy of Sciences, for the year 1719.

Secondly; Great quantities of vapours rise from fluids whose particles are put in a violent motion by any cause; as appears from the cloud constantly observed where there is a great fall of water.

The third, and seemingly the most general cause of the ascent of vapours into the atmosphere, is that power which the air has of attracting water, the particles of which being once separated from the mass, ascend

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with the air. Hence perhaps it is, that winds carry off great quantities of watery vapours, by bringing a greater number of particles of air into contact with the water. The air seems to have this effect independent of heat; for we find that in the severest winters, a great quantity of snow, and even of solid ice, evaporates into the air. This power is exerted very differently, according to the weight of the atmosphere. When it is heavy, and the quicksilver in the barometer rises high, then a great deal of water is taken up by the air: but when the quicksilver falls, or the atmosphere becomes lighter, then the air drops the watery vapour, in the form of dew, mist, rain, &c. Hence the use of the barometer, because it gives warning of these changes in the atmosphere, before their effects are either seen or felt by us. And hence we may account for an observation of Pliny's, that the speedy drying of the surface of the earth is a sign of a northerly wind and fair weather; and it's becoming moist, of southerly wind and rain. As the atmosphere approaches to it's greatest height, or the quick-

silver rises high in the barometer, the air takes up all the waste water on the surface of the earth, and so dries it. Hence the farmer may be instructed, never to trust a sun-shining day, while the surface of the earth continues wet; and to rely on a change to dry weather, as soon as he observes the moisture dried up, even though the appearance of the clouds should not be favourable.

This opinion is thus confirmed in the meteorological observations of the Academy of Sciences for the year 1742.

Since water imbibes and absorbs the air that touches it's surface, lodges it in it's interstices, making no longer but one body together; carries it along by it's motion of fluidity to the bottom of the vessel that contains it; and since air, notwithstanding it's specific gravity, which is much less than that of water, unites itself with it; it follows necessarily, that air may take up, absorb, and imbibe water on which it floats, and against which it is continually urged by the whole weight of the atmosphere; and that water, notwithstanding it's greater specific gravity,

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may insinuate itself into air, unite with it, follow all its motions, and make but an useless effort to fall back again, so long as it continues intimately mixed.

“ The air of itself,” says Dr. Halley,
“ imbibes a certain quantity of watery va-
“ pours, and retains them like salt dissol-
“ ved in water. The air abounding with
“ this water, being carried against the upper
“ parts of high and cold mountains, the
“ particles are condensed by the cold, and
“ fall to the earth, towards the north and
“ east, during the first part of the night,
“ and towards the south and west after mid-
“ night, as the air becomes colder. The
“ particles there uniting, are converted to a
“ real fluid, which glides gently down, or
“ entering into the caverns of the hills, is
“ gathered as in an alembic, descends into
“ lower places, and breaking out in the
“ sides of the hills, forms springs.

“ This theory of springs is not a bare hy-
“ pothesis, but founded on experience,
“ which it was my luck to gain in my abode
“ at St. Helena, where, in the night time,

“ on the tops of the hills, about eight hundred yards above the sea, there was so plentiful a precipitation of the vapours, that it was a great impediment to my celestial observations: for in the clear sky, the dews fell so fast, as to cover my glasses each quarter of an hour with little drops; so that I was necessitated to wipe them off so often: and the paper on which I wrote my observations, would be immediately so wet with dew, that it would not bear ink.” This account demonstrates how great a quantity of watery vapour there is in the upper regions of the air.

The vapours descend in the atmosphere from various causes. Whatever lessens the specific gravity of the air, causes bodies which before were equiponderant with it, to fall lower into spaces where the air is of the same specific gravity with them; or to fall out of it; as is seen in the receiver of an air-pump, upon drawing out some of the air. When vapours greatly rarified by heat, afterwards cool, and so become specifically heavier; or when any other propelling cause

ceases, they fall lower into a denser air. When several particles meeting together unite, whether by winds blowing from different quarters, or any other cause that creates an unequal motion in the air, whereby the watery particles come into more frequent contact, they become specifically heavier than the air, and therefore descend.

Clouds are the watery vapours collected together, so as to intercept a good deal of light, and render the air more opaque than usual: or clouds are only fog or mist raised higher in the air, and there floating about; as is experienced by travellers, who in crossing mountains covered with such clouds, never find them to be snow, or of any firm consistence, unless the mountains are so high as to reach the frozen region of the air. Clouds generally appear to be whiter than fog, owing to the quantity of light reflected from them as far as the sun shines on them. They rise to very different heights in the atmosphere, according to the specific gravity of the watery particles of which they are composed.

Fog is exhalations either rising slowly from the earth, or returning very slowly to it. When composed of watery vapours only, as those are which arise at sea, it is neither hurtful, nor stinks; but when of other exhalations, it often carries in them the seeds of many diseases. Fog is mostly seen in the night and morning, especially if the sun, in the day, has heated the earth much, which is again cooled after sun-set. This happens chiefly in spring and autumn; seldomer in the summer; because there is less difference between the heat of the day and night in the summer, than in spring and autumn. Fog sometimes wets like small rain, and then it is called *mist*.

In the summer, when the weather is fair, the heat of the sun penetrates to some depth into the earth, and not only water, but other volatile particles are carried up into the air, by the power of the solar rays, and float in it near the surface of the earth. As long as these exhalations are kept in agitation by the heat of the sun, so long nothing of them appears to the eye: but soon after the solar

exhalations

heat begins to remit, the air grows cool, whilst the earth, retaining it's heat much longer than the air, continues to breathe out exhalations: whence, in some places, arises a white visible vapour called *dew*; though in general the vapours remain invisible. This visible vapour appears first in watery or marshy places, whence dispersing itself by degrees, it covers the face of the lower grounds with a cloud in the evening and night. In the morning, it is again dissipated by the heat of the rising sun. This vapour must be of a very different nature in different places, according to the qualities of the various substances in the places whence it arises. For instance, in dry gravelly grounds of a large extent, the dew is entirely water, and usually invisible: while that which arises from standing waters, morasses, bituminous earths, or places abounding with the exhalations of putrid bodies, must have various substances in it, and may often be pernicious to health; and yet may be loaded with many particles fit for the nourishment of vegetables.

An opinion long prevailed, that the dew

which is collected on various parts of plants, was the watery vapour which fell from the air. Many and accurate experiments and observations evince, that the dew on plants is most frequently the sweat of the plants continually escaping through the orifices of their vessels; each plant having a different dew, where these orifices are the most numerous and open. This moisture exhales perpetually from plants, but is dissipated by the winds or heat during the day.

Rain is formed, when the watery particles composing a cloud approach so near to each other, that they unite into drops, which becoming specifically heavier than the air, they fall down, and in their descent light upon others, which increase their bulk to what we find them when they reach the earth. If the cause thus uniting them obtains equally through the cloud, and the vapours gradually unite into small drops very little specifically heavier than the air, they fall down in a misting rain. This may happen when the cause acts first in the lower part of the cloud, and gradually proceeds upwards. If

the cause first takes place in the upper part of the cloud, and proceeds gradually downwards, the small drops above falling down through others, unite with them; and this continually increasing, they reach the earth in large drops. In such a shower, a person ascending a mountain, will find the drops lesser as he ascends. The largest drops of rain fall in the summer, owing to the vapours being raised higher in the atmosphere at that time by the heat of the sun; whereas the force of the winter's sun raising the watery vapour to a less height, the rain falls then in small but numerous drops.

If watery exhalations meet with no cause to condense or dissipate them, they sometimes form a thick heavy dry air, which often lasts for several days, without either sun or rain. "In this case," says Dr. Derham, "I have scarce ever known it to rain, till it has been first fair, or till the sun has shone out. When this happens, the wind is generally in the easterly points; though I have known the same to happen be the wind where it will. I have per-

“ceived some small drops of rain, hail, and
“snow now and then falling, before any
“alteration hath happened in the weather.”

The higher the watery vapour is raised in the air, the more it's particles are dispersed in wider spaces; and they at the same time grow colder: for we constantly find that the heat lessens as we approach the summits of the highest mountains, where, even under the equator, a freezing cold preserves perpetual snow. There is therefore an orbit in the atmosphere concentrical with the earth, in which the water in the air is always frozen, if it's particles are united together. The height of this orbit varies in the higher latitudes, according to the season of the year, or warmth of the weather; as may be plainly discerned in mountainous countries, where the frost and snow descend gradually on the mountains, as the winter approaches. Hence the air and gusts of hurricanes are cold, though in hot countries and seasons, because they come from above. When water ascends to this orbit, it must necessarily be congealed into *ice*, unless it's particles

or elements are so far separated, that they do not touch one another. As soon as, from any cause, these particles descend, or come into contact, they form icy concretions, which float in the air, or falling on the surface of bodies they meet with, produce a fine *hoar frost*: or they may be collected in such quantities as to form *clouds*, or fall down in *snow*.

In the summer, and in warm climates, when the watery particles in this orbit, by their union, become heavier than the air is in the spaces they float in, they must fall downward into spaces more replete with vapour, where they unite with other particles, and so gradually form larger concretions, which put on the appearance of *snow* or *hail*. As they begin to unite, there will appear little clouds in the air, which falling downward with a considerable velocity, increase very fast in their magnitude, by condensing more vapour, till a violent storm ensues. It is probable that the hail, which is always formed in the upper and cold regions of the air, as it descends by it's weight

into those that are lower and warmer, is there dissolved by the heat, and produces those great showers of rain which accompany thunder and lightening. If the hail is carried so swiftly through the air, that, by reason of it's quick descent, it cannot be melted, it falls to the earth in icy concretions, which, by their size, weight, and motion, often do great damage. Hail-stones are seldom round or smooth, owing to the unequal accession of matter as they fall; and from their striking against one another, a noise is heard in the air.

Thunder and lightening have been variously accounted for in different ages. Since the invention of gunpowder, they have been generally ascribed to a mixture of nitrous and sulphureous vapours by some means set on fire in the air, and exploding like that powder: but though there is indeed something similar in the flash and noise, the other effects of lightening did not seem satisfactorily accounted for by such a cause.

Modern discoveries in electricity, and particularly those of that most skilful naturalist,

Dr. Benj. Franklin, whose soaring genius has realized the fable of Prometheus's bringing fire down from heaven, have furnished us with a better theory, now demonstrated by experiments to be the true one. For the electricians observing, that the appearances and effects of the electric fluid agreed with those of lightening in many particulars; *viz.* 1, in a sudden light given; 2, in the colour of the light; 3, in the crooked direction of the flame passing through the air; 4, in swiftness of motion; 5, in exploding with a noise or crack; 6, in being capable of subsisting in water or ice, and the lightening often proceeding out of clouds with rain and hail; 7, in rending some bodies; 8, in destroying animals; 9, in melting of metals; 10, in firing inflammable substances; and 11, in affording a sulphureous smell; they suspected the matter of lightening and the electric fluid to be the same: and as the electric fluid was found to be easily attracted by sharp metalline points, an experiment was proposed, to try if by erecting such points on high buildings, any electricity

could be obtained by drawing some of that fluid from the clouds. The experiment was made, and succeeded. The electric fluid drawn from the clouds, is found to have all the properties of that produced by the electric machine, and no other. Light bodies are attracted and repelled by it; bottles are charged (as the electricians speak) and persons are shocked with it; in short, it is demonstrated to be specifically the same. And it being among the known properties of the electric fluid, that it is easily conducted by any metal, and conveyed by metal rods or wires in any direction; and that it will leave other substances to pass in metal, and do them no damage so far as it can have metal to pass in; an useful inference has hence been drawn, *viz.* that buildings may be preserved from the stroke of lightening, by fixing pointed iron rods to the highest parts, with wires from such rods down to the ground, to receive and conduct the lightening to the earth.

Tall trees, and lofty buildings, as the towers and spires of churches, become some-

times conductors between the clouds and the earth; but not being good ones, that is, not conveying the fluid freely, they are often damaged.

Buildings which have their roofs covered with lead, or other metal, and spouts of metal continued from the roof into the ground to carry off the water, are never hurt by lightning, and whenever it falls on such a building, it passes in the metals and not in the walls.

When other buildings happen to be within the striking distance from such clouds, the fluid passes in the walls whether of wood, brick, or stone, quitting the walls only when it can find better conductors near them, as metal rods, bolts, and hinges of windows or doors, gilding on wainscot, or frames of pictures; the silvering on the backs of looking-glasses; the wires of bells; and the bodies of animals, as containing watery fluids. And in passing through the house it follows the direction of these conductors, taking as many in it's way as can assist in it's passage, whether in a strait or crooked line,

leaping from one to the other, if not far distant from each other, only rending the wall in the spaces where these partial good conductors are too distant from each other.

An iron rod being placed on the outside of a building, and continued from the highest part down into the moist earth, in any direction strait or crooked, following the form of the roof or other parts of the building, will receive the lightening at it's upper end, attracting it so as to prevent it's striking any other part; and, affording it a good conveyance into the earth, will prevent it's damaging any part of the building.

A small quantity of metal is found able to conduct a great quantity of this fluid. A wire no bigger than a goose quill, has been known to conduct (with safety to the building as far as the wire was continued) a quantity of lightening that did prodigious damage both above and below it; and probably larger rods are not necessary, though it is common in America to make them of half an inch, some of three quarters, or an inch diameter.

The rod may be fastened to the wall,

chimney, &c. with staples of iron.—The lightning will not leave the rod (a good conductor), to pass into the wall (a bad conductor), through those staples.—It would rather, if any where in the wall, pass out of it into the rod, to get more readily by that conductor into the earth.

If the building be very large and extensive, two or more rods may be placed at different parts, for greater security.

Small ragged parts of clouds suspended in the air between the great body of clouds and the earth (like leaf gold in electrical experiments), often serve as partial conductors for the lightning, which proceeds from one of them to another, and by their help comes within the striking distance to the earth or a building. It therefore strikes, through those conductors, a building that would otherwise be out of the striking distance.

Long sharp points communicating with the earth, and presented to such parts of clouds, drawing silently from them the fluid they are charged with, they are then attracted to the cloud, and may leave the

distance so great as to be beyond the reach of striking.

It is therefore that expert electricians elevate the upper end of the rod six or eight feet above the highest part of the building, tapering it gradually to a fine sharp point, which is gilt to prevent it's rusting.

Thus the pointed rod either prevents a stroke from the cloud, or, if a stroke is made, conducts it to the earth with safety to the building.

The lower end of the rod should enter the earth so deep as to come at the moist part, perhaps two or three feet; and if bent when under the surface, so as to go in a horizontal line six or eight feet from the wall, and then bent again downwards three or four feet, it will prevent damage to any of the stones of the foundation; especially if it can be made to terminate in a place where there is water.

This has been practised for some years past in several of our American colonies, where thunder storms are most frequent; and no house so guarded has ever been damaged by lightening.

A person apprehensive of danger from

lightening, happening during the time of thunder to be in a house not so secured, will do well to avoid sitting near the chimney, near a looking glass, or any gilt pictures or wainscot; the safest place is in the middle of the room, (so it be not under a metal lustre suspended by a chain,) sitting in one chair and laying the feet up in another. It is still safer to bring two or three mattresses or beds into the middle of the room, and folding them up double, place the chair upon them; for they not being so good conductors as the walls, the lightening will not chuse an interrupted course through the air of the room and the bedding, when it can go through a continued better conductor, the wall. But where it can be had, a hammock or swinging bed, suspended by silk cords equally distant from the walls on every side, and from the cieling and floor above and below, affords the safest situation a person can have in any room whatever; and what indeed may be deemed quite free from danger of any stroke by lightening.

Whoever would be more fully instructed

in these interesting points, will naturally, and very rightly, consult what Dr. Franklin himself has said in his *Philosophical Letters**, and particularly the LIXth.

* Subjoined to his *Experiments on Electricity*, printed in 1769.

SECTION II.

Prognostics of the Weather taken from Vegetables and Animals.

IT appears from numbers of instances, that the changes of the weather have very sensible effects on many animals and vegetables, and especially on the flowers of the latter, which open and expand their leaves as if to welcome the fair weather, and shut them to guard the tender fruit from the impending storms. This is remarkably apparent in the flowers of *pimpernel* (burnet), which Gerard, for that reason, terms the countryman's weather-glass; in the down of *dandelion* and other downs; and in the swelling and consequent erectness of the stalks of *trefoil*, against rain.

We do not know that animals have any powers fitting them for this quick sense more than men have; except that their fluids and vessels being constantly in a more equal state, owing to their uniform way of living, causes from without have a proportionally greater, or at least more sensible effect upon them, than on us, whose irregularities and inattention render many things imperceptible to us, which the brute creation are manifestly affected by. Virgil's beautiful description of of this sense in animals, is thus rendered by Mr. Dryden:

Wet weather seldom hurts the most unwise;
 So plain the signs, such prophets are the skies;
 The wary *crane* foresees it first, and sails
 Above the storm, and leaves the hollow vales:
 The *cow* looks up, and from afar can find
 The change of heav'n, and snuffs it in the wind.
 The *swallow* skims the river's wat'ry face,
 The *frogs* renew the croaks of their loquacious race.
 The careful *ant* her secret cell forsakes,
 And drags her eggs along the narrow tracks.
 Huge flocks of rising *rooks* forsake their food,
 And, crying, seek the shelter of the wood.

Besides, the sev'ral sorts of *wat'ry fowls*,
 That swim the seas or haunt the standing pools,
 Then lave their backs with sprinkling dews in vain,
 And stem the stream to meet the promis'd *rain*.
 The *crow*, with clam'rous cries the *show'r* demands,
 And single stalks along the desert sands.

— — — — —
 — — — — —
 Then, after *show'rs*, 'tis easy to descry
 Returning suns, and a *serener* sky.

— — — — —
 Their litter is not toss'd by *sows* unclean,
 — — — — —
 And *owls*, that mark the setting sun, declare
 A star-light ev'ning, and a morning *fair*.

— — — — —
 Then, thrice the *ravens* rend the liquid air,
 And croaking notes proclaim the *settled fair*:
 Then round their airy palaces they fly
 To greet the sun; and seiz'd with secret joy
 When storms are over-blown, with food repair
 To their forsaken nests and callow care.

GEORG. I.

Likewise, against *rain*, numbers of *earth-worms* will creep out of the ground, *moles* cast up more earth than usual, *fleas* bite more than common, *spiders* crawl more

abroad, *flies* become uncommonly troublesome, and *bees* stir not far from their hives. On the contrary, *spiders webs* in the air, or on the grass or trees, foretell very *fair* and *hot* weather: so do *bees*, when they fly far from their hives, and come late home; and likewise a more than usual appearance of *glow-worms* by night. *Gnats* too are said to foretell the weather, in that, if they play up and down in the open air near sun-set, they presage *heat*; if in the shade, warm and mild *showers*; but if they join in stinging those that pass by them, *cold* weather and much *rain* may be expected.

Again; *larks* rising very high and continuing to sing for a long time, and *kites* flying aloft, are signs of *fair* and *dry* weather.

In *men*; frequently, aches, wounds, and corns are more troublesome, either towards *rain*, or towards *frost*.

SECTION III.

*Prognostics of the Weather, taken from the Sun, Moon,
and Stars.*

INOW proceed to the shepherd of Banbury; whose rules to judge of the weather I shall give, and at the same time examine how far they are confirmed by reason and other authorities.

1st Rule. If the sun rise red and firey—
Wind and Rain.

2d Rule. If cloudy, and the clouds soon decrease—*Certain fair weather.*

The shepherd begins with observations arising from the different appearances of the sun. These rules may be extended to all the heavenly bodies: for as their rays pass through the atmosphere, the vapours in the air have the same effect on each.

The *rain-bow* shews us that the rays of light admit of different degrees of refraction, and that according to those different degrees of refraction, they appear of different colours. A clear unclouded sky teaches us,

that while the vapours are equally dispersed in the atmosphere, the rays reach us without undergoing a change, or variety of colours. It is known to those conversant in experimental philosophy, that this refraction of the rays of light arises from a difference in the density of the medium through which the rays pass. It seems probable, that while the watery vapour in the air is divided into its minutest particles, it perhaps only reflects the rays of light, but does not refract them till collected into the form of water, as into clouds, rain, &c. When the farmer therefore sees the sun or moon rise or set red and fiery, or sees the clouds and horizon of that colour, he may expect wind and rain, owing to the unequal distribution of the vapours, or to their being already collected into watery globules by some preceding cause. Thus Virgil;

Observe the daily circle of the *sun*,
 And the short year of each revolving *moon* :
 By them thou shalt foresee the following day ;
 Nor shall a starry night thy hopes betray.
 When first the *moon* appears, if then she shrouds
 Her silver crescent, tipp'd with sable clouds ;

Conclude she bodes a tempest on the main,
 And brews for fields impetuous floods of *rain*.
 Or if her face with firey flushings glow,
 Expect the ratling *winds* aloft to blow.
 But *four* nights old, (for that's the surest sign)
 With sharpen'd horns if glorious then she shine;
 Next day, nor only that, but all the moon,
 Till her revolving race be wholly run,
 Are void of tempests both by land and sea.

— — — — —
 Above the rest, the *sun*, who never lyes;
 Foretells the change of weather in the skies:
 For if he rise unwilling to his race,
 Clouds on his brow, and spots upon his face;
 Or if through mists he shoots his fullen beams,
 Frugal of light, in loose and straggling streams;
 Suspect a *drisling* day with southern *rain*.

— — — — —
 Or if *Aurora*, with half open'd eyes,
 And a pale sickly cheek salutes the skies;
 How shall the vine, with tender leaves defend
 Her teeming clusters, when the *storms* descend?

— — — — —
 But more than all, the *setting sun* survey,
 When down the steep of heav'n he drives the day:
 For oft we find him finishing his race,
 With various colours erring on his face.

In firey *red* his glowing globe descends,
 High *winds* and furious *tempests* he portends :
 But if his cheeks are swoln with livid *blue*,
 He bodes *wet* weather by his wat'ry hue :
 If *dusky* spots are vary'd on his brow,
 And streak'd with *red*, a troubled colour show ;
 That fullen mixture shall at once declare
Winds, rain, and storms, and elemental war.

— — — — —
 But if with *purple* rays he brings the light,
 And a pure heav'n resigns to quiet night ;
 No rising *winds*, or falling *storms* are nigh.

The *circle* which frequently appears about the *moon*, and sometimes about the *sun*, as also the *mock-suns* and *moons*, proceeding from the great quantity of watery vapour loading the lower air, likewise presage *rain* or *wind*, and often both.

If, according to the *second* rule, the sun rises *cloudy*, and the clouds soon decrease, the vapours are more equally distributed in the atmosphere ; which equal distribution is also promoted by the warmth of the rising sun. Hence we may account for an observation adopted into all languages,

*The evening red, and the morning grey,
is a sign of a fair day.*

For if the abundance of vapour denoted by the *red* evening sky falls down in dew, or is otherwise so equally dispersed in the air, that the morning shall appear *grey*, we may promise ourselves a *fair* day, from that equal state of the atmosphere.

If, in the morning, some parts of the sky appear *green* between the clouds, while the sky is *blue* above, *stormy* weather is at hand.

The great lord Bacon gives us the following rules to judge of the ensuing weather from the first appearance of the *moon*, and it is said that these observations of his have never been known to fail.

1st. If the *new moon* does not appear till the *fourth* day, it prognosticates a *troubled air* for the whole month.

2^d. If the *moon*, either at her first appearance, or within a few days after, has her *lower* horn obscured or dusky, or any ways sullied, it denotes *foul weather* before the full; but if she be discoloured in the *middle*,

storms are to be expected about the full, or about the wane if her *upper* horn is affected in like manner.

3d. When the moon, on her *fourth* day, appears pure and spotless, her horns unblunted, and neither flat nor quite erect, but betwixt both, it promises *fair weather* for the greatest part of the month.

4th. An *erect* moon is generally *threatning* and *unfavourable*, but particularly denotes *wind*; though if she appear with short and blunted horns, *rain* is rather expected.

SECTION IV.

Prognostics of the Weather taken from the Clouds.

THE shepherd's 3d rule. Clouds small and round, like a dappled grey, with a north wind, portend *fair weather* for two or three days.

4th Rule. Clouds large like rocks,—*great showers.*

5th Rule. If small clouds increase,—*much rain.*

6th Rule. If large clouds decrease,—*fair weather.*

7th Rule. In summer or harvest, when the wind has been south two or three days, and it grows very hot, and you see clouds rise with great white tops like towers, as if one were on the top of another, and joined together with black on the neither side, *there will be thunder and rain suddenly.*

8th Rule. If two such clouds arise, one on either hand, *it is time to make haste to shelter.*

The third rule seems contrary to an observation mentioned by Mr. Worlidge, viz. that “in a fair day, if the sky seem to be dappled with white clouds, (which they usually term a mackarel sky,) it generally predicts *rain.*” This is confirmed by a very ingenious gentleman, who has constantly observed, that “in dry weather, so soon as clouds appear at a great height striped like the feathers in the breast of a hawk, *rain* may be expected in a day or so.”

Mr. Worlidge proceeds thus. “In a clear evening, certain small black clouds appear-

ing, are undoubted signs of *rain* to follow; or if black or blue clouds appear near the sun at any time of the day, or near the moon by night, *rain* usually follows.

“ If small waterish clouds appear on the tops of hills, *rain* follows; as they observe in Cornwall, that

“ *When Hengston is wrapped with a cloud, a shower follows soon after.*

“ The like they observe of Rosemary-topping, in Yorkshire, and many other places in England.

“ If clouds grow or appear suddenly, the air otherwise free from clouds, it signifies *tempests* at hand, especially if they appear to the south or west.”

If many clouds, like fleeces of wool, are scattered from the east, they foretel *rain* within three days.

When clouds settle upon the tops of mountains, they indicate *bad* weather.

When the tops of mountains are clear, it is a sign of *fair* weather.

The account before given of the nature and cause of clouds, explains sufficiently these

rules of the shepherd and Mr. Worlidge. As an illustration of the seventh and eighth rules, I shall give the following supposition from Boerhaave's chemistry.

“ If a large white, what may be supposed a frozen cloud, be opposed to the sun, the rays reflected by the side next the sun must rarefy or heat the air betwixt it and the sun, while at the same time, allowing that the cloud is not transparent, the cold will be great in the part turned from the sun, and the air so much the denser: whence must arise a violent motion of the cloud, which will be the more rapid, the greater the sun's heat is on one side, and the keener the cold is on the other side. If a few such clouds are so disposed, that their joint effects meet in one place, which may often be the case, it is easy to conceive that a very great heat must suddenly arise in such a place, and the air be as greatly expanded therein. On a change of the situation of the clouds, and a consequent dissipation of the rays of the sun, the heat ceases, and the cold air, snow, hail, rain, or other substances near at hand, will

rush violently into the spaces so heated ; whence most stupendous and destructive effects may be produced. Hence it will not be surprising, that a small cloud appearing in a clear sky, in a hot climate, still increasing till it reaches the earth, produces those direful effects travellers acquaint us they meet with in certain latitudes : and thus, even in our northern climate, small white clouds are sometimes seen at a good height, especially after a drought or calm, continually increasing, and as they increase, turning less and less white, till at length they burst down in heavy showers, which falling in large drops, shew that they come from a considerable height, and that they had probably been hail. As the air admits of greater rarefaction than water, the watery vapour must consequently precipitate out of the heated rarefied air. From this cause the inequality of rain in such showers may proceed."

AN ESSAY ON

SECTION V.

Prognostics of the Weather taken from Mist,

NINTH Rule. If mist rises in low grounds and soon vanishes,—*fair weather.*

10th Rule. If it rises up to the hill tops,—*rain in a day or two.*

11th Rule. A general mist before the sun rises, near the full moon,—*fair weather.*

12th Rule. A general mist before the sun rises, if in the new moon,—*rain in the old.*

13th Rule. A general mist before sun rises, if in the old moon,—*rain in the new.*

Upon a careful perusal of a register of the weather, kept near Oundle in Northamptonshire for several years, and which will be inserted in these sheets, I do not find that the twelfth and thirteenth rules hold so universally true, as to be established rules to judge of the weather. Though this register bears the marks of judgment and great accuracy, and it's having been sent to the Royal Society gives it a

sufficient sanction for truth; and though these rules appear to me in this light, yet the fact may be as mentioned by the shepherd.

It might be expected, that as the joint attractions of the sun and moon have so apparent and great effects on the tide, the same influence would be manifest on our atmosphere and it's contents. Thus, if the atmosphere is loaded with watery vapours in the second and fourth quarters of the moon, it would seem probable, that as their joint attractions daily coincide more and more till the new and full moon, so long the vapours would be suspended; but that, as after the change, or full moon, their joint attractions lessen every day till the first and third quarter, these vapours would fall down in rain in those quarters of the moon. This opinion, of the weather's being influenced by the age of the moon, is of very long standing; and perhaps in countries where the causes of the changes of the weather act more uniformly, the case may be so. As far as I can judge from the above-mentioned register, the changes of the weather seem to be influenced

more by the moon's place in the ecliptic, than by her age: yet this is not so constant as to make it an established rule. The influence which the moon is observed to have on the tide, would naturally lead men to expect her having the same influence on the weather: and when an opinion once obtains, that a change of the weather happens at certain times, the change is expected; and as often as it takes place, the remembrance of it remains; but we soon forget the number of times it fails, unless the mind is assisted by a faithful journal of the weather.

While speaking of mists, I think I ought not to omit the following observation, recorded in the memoirs, &c. of the Berne Society, for the year 1763.

In large forests, where the sun never penetrates, there reigns a constant cold; and that it is which renders the air of Swisserland, for example, particularly sharp, and frequently occasions those heavy showers of hail, and other storms, which the inhabitants of that country so often experience. Thus, as is remarked by one of their ingenious writers,

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in the west part of the Pays de Vaud, when they see in the morning a small cloud arise over the woods, even in fine calm weather, when no other cloud appears, it seldom happens but that a storm falls in the evening. They observe, that when a mist arises over a certain very cold fountain in the forest of Gibloux, there will certainly be a storm on the same day.

SECTION VI.

Prognostics of the Weather taken from Rain.

FOURTEENTH Rule. Sudden rains *never last long* : but when the air grows thick by degrees, and the sun, moon, and stars shine dimmer and dimmer, *it is likely to rain six hours usually.*

15th Rule. If it begins to rain from the south, with a high wind, for two or three hours, and the wind falls, but the rain continues, *it is likely to rain twelve hours or more ; and does usually rain till a strong north wind clears the air.* These long rains seldom hold

above twelve hours, or happen above once a year.

16th Rule. If it begins to rain an hour or two before sun-rising, *it is likely to be fair before noon, and to continue so that day*: but if the rain begins an hour or two after sun-rising, *it is likely to rain all that day, except the rainbow be seen before it rains.*

A sudden rarefaction of the lower air, or perhaps more frequently a cold cloud descending from above, or cold wind descending from above and condensing the invisible vapours so as to form a cloud, are the most frequent causes of sudden rain. The rain therefore ceases as soon as an equal temperature is restored to the atmosphere: but if the vapours are collected in the manner described in the latter part of the *fourteenth* rule, it is no wonder that the rain continues longer.

In the state of the air described in the *fifteenth* rule, the mercury in the barometer will always be found low, which indicates that the atmosphere is light. The rain therefore continues to fall, till a cooler and denser

air from the north enables the atmosphere to support the vapours.

The duration of the rain in an inland country, like Oxfordshire, where the shepherd lived, may not exceed *twelve hours*; but I doubt this will not hold as a general rule either of it's duration or frequency in all places; for near the sea, rains happen often which last a whole day.

Mr. Worlidge mentions the following signs of *rain*.

“ The audibility of sounds are certain prognostics of the temper of the air in a still evening: for if the air be replete with moisture over us, it depresseth sounds, so that they become audible to a greater distance than when the air is free from such moisture or vapours. From whence you may conclude, that in such nights or other times that you hear sounds of bells, noise of water, beasts, birds, or any other sounds or noises more plainly than at other times, the air is inclinable to rain, which commonly succeeds.

“ I have often observed that the sinking

of rivers more than usual at such seasons of the year, hath been a certain presage of much *rain* to follow; and that the continuing fall of rivers after rain, hath been a sure presage of *dry* weather.

“ If the earth, or any moist or fenny places yield any extraordinary scents or smells, it presageth *rain*.

“ If dews lie long in the morning on the grass, &c. it signifies *fair* weather: but if they rise or vanish suddenly and early in the morning, it presageth *rain*.

“ There is a small bird, of the size and near the shape of a marten, that at some times flies very near the water, which is a most sure prognostic of *tempestuous* weather; never appearing but against such weather, as hath been constantly observed by the boatmen in the Severn, and channel between the Isle of Wight and the main land.

“ Ducks and geese picking their wings, washing themselves much, or cackling much, signifies *rain*.

“ If after rain comes a cold wind, it signifies more *rain*.

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“ The nightly virgin, whilst her wheel she plies,
Foresees the *storm* impending in the skies,
When sparkling lamps their sputt’ring light advance,
And in their sockets oily bubbles dance.

SECTION VII.

Prognostics of the Weather taken from the Winds.

WHEN the atmosphere is of the same weight and density over a considerable extent of the surface of the earth, there a calm will obtain: but if this equipoise is taken off, a stream of air, or wind, is thereby produced, stronger or weaker in proportion to the alteration made in the state of the atmosphere. There are divers causes which make these alterations in the equipoise of the atmosphere; such as rarefactions or condensations in one part more than in another; vapours rising from the earth or sea, pressure of the clouds, &c. I shall not attempt here to enter into a disquisition concerning the causes of winds in general, but refer the curious to lord Bacon, Mr. Bohun, Dr.

Halley, Dr. Franklin, and others who have written more fully on this subject, and confine myself chiefly to the winds so far as relates to this island.

We may assign three causes of our stated winds in this island. The first of these stated winds is the *westery*, which so frequently obtains every where beyond the limits of the trade wind, and has been most judiciously accounted for by Dr. Franklin, in his philosophical works (*p* 188, *et seq*). This general westerly wind is found to blow mostly from the north-west in the Ocean, and where other causes do not intervene. Lord Bacon mentions the other two causes, as having been long observed, *viz.* that winds blow most frequently from the sea; and next, that where there are high mountains covered with snow, stated winds blow from that quarter at the time the snow dissolves.

Lord Bacon imputes the frequency of the winds from the sea, to the copious ascent of watery vapour from it; and as signs that such vapours do ascend from it, he observes, that “ the sea and lakes sometimes swell

very considerably, though no winds are found to blow, which," says he, "it is probable is occasioned by the warm vapour rising out of the earth under the water. At such times a kind of murmuring noise is heard, the sounding of the shore is heard to a greater distance than usual, and sometimes a froth or watery bubbles are seen on the sea, whilst it is flat and calm. Hence miners foretel storms, by the muddiness of the water, or by the fumes which rise in mines, before any signs appear above ground." Mr. Bohun relates, that, in Cornwall, they have so sure prognostics of storms at sea, from their mines, that the fishermen never presume to tarry out, when the signal is given by the eruption of certain meteors, which immediately presage a tempest. In St. Owen's bay, in the isle of Jersey," continues he, "the sea is often strangely disturbed before the western storms, even when the air is very calm; and though no wind be stirring, yet the roaring of the waves may be heard, not only over the whole isle, but into France,

about thirty miles distant, which is the certain prognostic of an ensuing tempest."

This agitation of the sea, and noise of the water, may be occasioned by a storm in the Atlantic Ocean, with the wind at west; for as the storm proceeds eastward, the waves raised by it will greatly out-go the wind, and thereby reach the eastern coast some hours before the wind arrives there. It is probable, that if any storms arise from vapours ascending thus from the earth under the sea, they are only such as are very violent: for that power which the air has of taking up water, will supply sufficient to occasion the winds so frequent from the sea, and is perhaps their most general cause.

Wind, as the reverend and ingenious Mr. Borlace very properly remarks*, is air in motion, excited by various causes. The sun, by concurrent circumstances in land, water, and vapour, lightens and disperses the air from one place, and at one time, more than at another. Inflammable exhalations, and

*a notable
& truly ingenious
Discovery*

* In his excellent Natural History of Cornwall, p. 8.

other explosions shall warm and thin the air in particular places. A cloud or portion of vapour full of electrical matter, passing over a cloud or region of land more destitute of electrical matter, will shed streams of fire upon the less electric body, and thereby excite violent motions, &c. Now, wherever the air is thrown into a state of rarefaction, there a vacuity is produced, and the adjacent air flows as water to the breach of a dam, and the flood is either violent or not, as the space through which it passes is shaped; lasting as the quantity of fluid set in motion, and as the extent of the vacuity is to be replenished. If the vacuity be spacious, the flow will be plentiful (obstructions in the way being allowed for); if the channel through which the influx runs be long, narrow, and funnel-like, the velocity will be great, and *vice versa*; but if a large quantity of condensed air chances at this time to press forward towards this large vacuity, the motion of the air will be impetuous, or what we call a *storm*. If, on the other hand, the rarefactions in particular districts be gentle,

and there is room for denser air to succeed without violence, the motion also is gentle; and where no extraordinary rarefactions are produced, and the vapours are equally dispersed, a calm ensues.

If rarefying vapours assume the shape of an oblate disk, over spreading as a canopy a wide extent, the weight and continuity of the incumbent air is in this district, for a time, and to a certain degree, suspended; the mercury sinks in the barometer, and at the same time the current of the air above this disk shall go one way, towards any vacuity which shall create a fresh tendency, and the under current of air, influenced by another rarefaction, shall go in a different, perhaps opposite direction; there being no communication between the currents above and below the disk of vapours, sufficient to determine them to one point. Thus again, by the fall or even recess of a great body of vapours in one place out of our sight, the air over our heads before condensed, and keeping the mercury high, extends itself into the vacuity, the wind blows, and the mercury falls

in a serene sky, to our surprize. By the rising of a like body of vapours, and accumulating the air of our horizon, the mercury rises in a cloudy and even rainy sky. When the wind is violent, the perpendicular pressure of the air is much lessened by the velocity of the horizontal motion, and the mercury falls. When the air is fullest of vapours, the mercury falls; the pressure of the atmosphere depending not only on the weight of the fluid, but also on the agility and elasticity of the column of air which is broken and interrupted by such a quantity of moisture floating between, condensing, and ready to fall. These and many other variations which might be mentioned, are the necessary results of meteors, vapours, and air intermixed in separate portions, and acting with reciprocal, but, generally, very different powers.

The most common and the most violent winds in France come almost always from the south-west, and they very often bring rain; because there rise more vapours from the sea to load these winds, than those which

blow from the east : and it has been observed that clouds never fail to increase the force of the wind. The reason may be this, that the wind, though in itself moderate, being confined between the clouds and the earth, it's violence must in consequence be augmented.

It has frequently been remarked, that the winds in the upper region of the air, as may be seen by the motion of the clouds, are very different from those near the surface of the earth*.

A sign of a change of weather which seemed new and singular to Mr. Borlace†, was thus, August 15, 1752, the wind at west-north-west, the sky cloudy, the mercury moving upward in the barometer, at about six in the evening, there appeared in the north-east the frustrum of a rain-bow. All the colours were lively and distinct. They call it in Cornwall a weather-dog, or weather's-eye, and pronounce it a certain sign of hard rain. The mercury fell $\frac{2}{16}$, and that without rain. The next morning was dry, but

* *Memoirs de l'Academie Royale des Sciences, pour l'an 1717.*

† *Natural History of Cornwall*, p. 17.

not clear : at about eleven it began to rain gently, and at one a flood of rain came on, which continued all night and till the next morning.

Virgil describes thus the signs of an approaching *tempest* :

For ere the rising winds begin to roar,
The working sea advances to the shore ;
Soft whispers run along the leafy woods,
And mountains whistle to the murm'ring floods ;
And chaff with eddy winds is whirl'd around,
And dancing leaves are lifted from the ground,
And floating feathers on the waters play.

Our *northerly* winds in the beginning of the winter may arise from the weight of the cold northern air overcoming the warmer southern air, which, as the heat lessens, is less loaded with vapours, and therefore more easily gives way to the cold northern and denser air. Hence the frequency of north-west winds at that season.

The most general cause of the *easterly* winds in the spring and beginning of summer, arises from the melting of the snow on the continent, as observed by lord Bacon. The

warmth which constantly obtains in a thaw, raises not only much of the melting snow in the air, but the exhalations which had been so long confined by the frost, rise copiously into the air, and become the cause of our easterly winds, which are observed to blow more or less in proportion to the duration and severity of the winter on the continent.

“ Seas, lakes, and great bodies of water, agitated by the winds, continually change their surfaces, as is justly remarked by Dr. B. Franklin*; the cold surface in winter is turned under, by the rolling of the waves, and a warmer turned up; in summer, the warm is turned under, and colder turned up. Hence the more equal temper of sea-water, and of the air over it. Hence in winter, winds from the sea seem warm, winds from the land cold. In summer the contrary.

“ Therefore it is that the lakes west of Pennsylvania, as they are not so much frozen nor so apt to freeze as the earth, rather mo-

* Letters and Papers on Philosophical Subjects;
Letter XV.

derate than increase the coldness of the winter winds in that part of America.

“ The air over the sea being warmer, and therefore lighter in winter than the air over the frozen land, may be another cause of the general north-west winds, which blow off to sea at right angles from the North-American coast. The warm light sea air rising, the heavy cold land air pressing into it's place.

“ Heavy fluids descending, frequently form eddies, or whirlpools, as is seen in a funnel, where the water acquires a circular motion, receding every way from a center, and leaving a vacuity in the middle, greatest above, and lessening downwards, like a speaking trumpet, it's big end upwards.

“ Air descending, or ascending, may form the same kind of eddies, or whirlings, the parts of air acquiring a circular motion, and receding from the middle of the circle by a centrifugal force, and leaving there a vacancy; if descending, greatest above, and lessening downwards; if ascending, greatest below, and lessening upwards; like a speaking trumpet standing with it's big end on the ground.

“ When the air descends with violence in some places, it may rise with equal violence in others, and form both kinds of whirlwinds.

“ The air in it's whirling motion receding every way from the center or axis of the trumpet, leaves there a vacuum, which cannot be filled through the sides: the whirling air, as an arch, preventing: it must then pass in at the open ends.

“ The greatest pressure inwards must be at the lower end, the greatest weight of the surrounding atmosphere being there. The air entering, rises within, and carries up dust, leaves, and even heavier bodies that happen to be in it's way, as the eddy, or whirl, passes over land.

“ If it passes over water, the weight of the surrounding atmosphere forces up the water into the vacuity, part of which, by degrees, joins with the whirling air, and adding weight, and receiving accelerated motion, recedes still farther from the center or axis of the trump, as the pressure lessens; and at last, as the trump widens, is broken

into small particles, and so united with air as to be supported by it, and become black clouds at the top of the trump.

“ Thus these eddies may be whirlwinds at land, water-spouts at sea. A body of water so raised may be suddenly let fall, when the motion, &c. has not strength to support it, or the whirling arch is broken so as to let in the air: falling in the sea, it is harmless, unless ships happen to be under it. But if in the progressive motion of the whirl, it has moved from the sea, over the land, and there breaks; sudden, violent, and mischievous torrents are the consequences.”

Without entering, however, into the causes of the frequent changes of our winds, which philosophers are not yet agreed upon, I shall now proceed to the shepherd's rules relating to the winds.

17th Rule. Observe that in eight years time, *there is as much south-west as north east winds, and consequently as many wet years as dry.*

18th Rule. When the wind turns to north-east, and it continues there two days without

rain, and does not turn south the third day, nor rain the third day, *it is likely to continue north-east for eight or nine days all fair, and then to come south again.*

19th Rule. If it turn again out of the south to the north-east with rain, and continues in the north-east two days without rain, and neither turns south nor rains the third day, *it is likely to continue north-east two or three months.*

The wind will finish these turns in three weeks.

20th Rule. After a northerly wind for the most part of two months or more, and then coming south, *there are usually three or four fair days at first, and then on the fourth or fifth day comes rain, or else the wind turns north again, and continues dry.*

21st Rule. If it returns to the south within a day or two without rain, and turns northward with rain, and returns to the south in one or two days as before, two or three times together after this sort, *then it is like to be in the south or south-west two or three months together, as it was in the north before.*

The winds will finish these turns in a fortnight.

22d Rule. Fair weather for a week with a southern wind, *is like to produce a great drought*, if there has been much rain out of the south before. The wind usually turns from the north to south with a quiet wind without rain; but returns to the north with a strong wind and rain. The strongest winds are when it turns from south to north by west.

When the north wind first clears the air, which is usually once a week, *be sure of a fair day or two*.

23d Rule. If you see a cloud rise against the wind, or side wind, when that cloud comes up to you, *the wind will blow the same way the cloud came*. The same rule holds of a clear place, when all the sky is equally thick, except one clear edge.

After carefully comparing the shepherd's 17th rule with the afore-mentioned journal of the weather, kept at Southwick near Oundle, I am sorry to say that they do not agree. Left the reader should think that justice is not done to the shepherd in this censure, I shall here

give an abstract of every month during the eleven years that this journal was sent to the Royal Society. It will appear from thence, that the number of days of westerly winds greatly exceeds the number of easterly, and that during the eleven years, the sum total of the south-west doubles the number of the north-east. To put it in the most favourable light, the greatest number of north-east winds in any year is 63 days, viz. in the year 1739; and the least number of south-west is 70 days, viz. in 1729. There is not one instance in the eleven years, where the easterly winds continued two or three months, according to the 19th *rule*. If we attend to the two great causes of westerly winds, viz. the general north-west trade wind, if I may so call it, and the Atlantic ocean to the south-west of us, we may rather wonder what cause can counteract them so frequently as we find the easterly winds do.

R E S U L T

O F A

JOURNAL of the WEATHER

K E P T A T

S O U T H W I C K,

Near Oundle, in Northamptonshire,

From the Year 1729 to the Year 1739,
inclusive.

	N.	N.E.	E.	S. E.	S.	SW.	W.	NW	Barom.	Rain.
1729									0 \	in dec.
Janu.	2	2	1	3	2	10	6	4	29.70	.16
Febru.	4	2	6	5	1	1	5	4	.66	.48
March	6	3	3	2	5	3	4	5	.54	1.31
April	6	10	7	2	1		3	1	.60	1.10
May	1	4	5		3	6	6	6	.57	1.55
June	3		2	6	2	10	4	1	.69	.83
July	1	8	4		8	2	6	2	.64	2.26
August	5	1	1	1	9	6	1	5	.72	2.44
Septem		5	6	6	3	5	1	4	.42	5.32
Octo.	1	3	7	4	2	5	7	2	.52	2.20
Novem	1	1		5	4	10	4	5	.32	4.18
Decem.	1		3	5	4	12	1	5	.52	1.16
	31	39	45	39	44	70	48	44		23.9
1730.										
Janu.	3	4	7			7	4	6	29.79	.45
Febru.	3		1	1	4	8	5	6	.39	1.53
March			4	4	7	7	4	3	.34	2.61
April	2	4	2		2	6	5	6	.66	.84
May	4	4	2	4	6	5	3	4	.55	2.50
June	3	2	2	3	2	9	4	4	.60	3.39
July	1			1	3	10	7	9	.61	1.93
August	1	3	4		2	4	9	6	.70	.85
Septem	2	2	4	6	3	4	6	2	.34	1.65
Octo.	1	1	7	4	1	12	3	1	.49	2.94
Novem	2	1		1	3	9	4	10	.55	1.93
Decem.	4	3	5		2	4	5	8	.83	.81
	27	24	38	26	37	90	56	60		21.43
1731.										
Janu.	8	4	2	2		2	2	10	29.61	.81
Febru.	4	4	3	2	4	7		4	.57	1.04
March	4	5	2			5	6	9	.92	.15
April	2	11	5	3	2	1	1	3	.51	2.07
May	5	3	3	3	6	10	1	2	.72	.38
June	3	4	1	2	2	6	2	7	.66	3.38
July	3	2	2	3	2	9	2	7	.72	1.65
August	4	8	6	3	4	3	1	3	.65	1.56
Septem		2	1	4	3	10	5	5	.70	1.47
Octo.		3	1	11		12	2	2	.67	1.34
Novem	2	2	3	2	2	6	4	8	.54	1.49
Decem.	1	4	1	1		9	6	9	.61	2.30
	16	52	30	36	25	80	32	69		17.64

	N.	N.E.	E.	S. E.	S.	SW.	W	NW	Barom.	Rain.
1732.									0	in dec.
Janu.	1	5	2	4	5	9	1	4	29.54	.88
Febru.		1		3		16	3	6	.65	1.22
March	4	2	3	1	1	8	1	11	.57	1.41
April	8	3	1	2	4	5	1	6	.52	1.20
May	3	5		2	4	10	5	2	.50	3.47
June	2	6	5	2		4	4	7	.75	.61
July	2	6		2	3	10	8	5	.65	1.77
August	2	1	5			10	5	2	.70	1.67
Septem	1	3	3	3	1	9	5	3	.61	.72
Octo.		1	5	4	4	10	1	5	.68	3.73
Novem	4	8	3	3			1	8	.75	1.21
Decem	2	4	5	6	4	7	3	2	.47	2.63
	29	45	34	32	26	98	38	61		20.42
1733.										
Janu.	1	1	3	5	8	11	1		29.68	1.01
Febru.					4	14	5	5	.55	1.43
March	2	7	3	3	1	6	3	6	.43	2.25
April	2	10	3	3	4	1	3	4	.65	1.04
May	8	9	6	3			3	1	.70	.02
June	1	2	3	6	1	10	2	4	.67	2.04
July	3	3	1	4		3	5	12	.67	2.17
August		2	1		1	11	2	11	.56	3.58
Septem	2	1	2	3	1	12	1	7	.62	1.45
Octo.		2	4	3		8		10	.72	.62
Novem		1	1	3	1	12	5	7	.75	.49
Decem			1	1	3	20		5	.53	1.70
	19	38	28	34	24	108	30	72		17.80
1734.										
Janu.	2	2	4	3	4	7	1	8	29.80	.50
Febru.		1			2	10	2	13	.60	2.57
March			1	3	3	12	2	9	.52	1.85
April	2	4	3	3	1	11	2	4	.65	.59
May	3	2	1	5		6	2	11	.54	5.12
June	2	4	3	4	1	6	4	6	.65	1.32
July	3	2	3	2	2	5	8	5	.63	1.76
August	3	2		4		13	1	8	.57	4.06
Septem	5		1	1		12	3	7	.57	1.73
Octo.	3	7	2		2	7	2	6	.47	2.83
Novem	1	11	3	1		9	3	2	.74	.94
Decem.	1		1	2	2	20	3	1	.22	4.40
	25	35	22	28	17	118	33	80		27.67

	N.	N.E.	E.	S. E.	S.	SW.	W	NW	Barom.	Rain.
1735.									0	in. dec.
Janu.		4	1	2	2	7	2	13	29.47	2.07
Febru.	3	1				15	2	4	.63	.69
March		10	5	3	3	4	2	4	.36	2.21
April		4	1	2	1	15	3	4	.49	1.65
May	11	3	2	1		5	1	7	.60	1.53
June	3	2		2	3	7	4	8	.56	2.36
July	2	1	1	3	2	13	2	4	.50	2.29
August	2	3	2	3	3	9	4	4	.72	3.23
Septem	1	5	1	5		13	3	2	.69	3.17
Octo.		5	6	7	2	2	2	5	.69	1.68
Novem		2		6	8	5	3	5	.45	1.67
Decem		1	7	4	4	8	2	5	.59	2.11
	22	41	26	40	28	103	30	65		24.66
1736.										
Janu.		3	1	7	3	11	4	1	29.26	2.32
Febru.	1	10	2	3		4	1	8	.22	2.94
March		6	4	7		10	3	1	.44	2.06
April		2	2	2	3	5	7	9	.70	.56
May	2	10	2	5	1	3	2	5	.58	.81
June	3	11	1	2		2		11	.76	1.36
July	2	7		5	1	8	1	7	.67	5.90
August	2	2	2	3	1	14	1	5	.63	1.74
Septem	1			1	3	8	4	13	.71	1.40
Octo.	1	2	3	4	5	10	4	2	.33	2.63
Novem		2	1	2		8	3	14	.64	.59
Decem	1			1		16	1	12	.53	1.98
	13	55	18	42	17	99	31	88		24.29
1737.										
Janu.	1	2				11	2	16	29.86	.98
Febru.	1	1		1		16	2	7	.58	2.45
March	1	10	3	4		10	1	1	.67	.45
April	2	4	3	5	1	7	3	6	.45	2.12
May	4	9	4	7	1	2	1	2	.70	1.67
June	5	3		2	3	6	3	8	.73	1.83
July		4		3	3	9	4	8	.59	.67
August	1	1	1		2	5	5	16	.55	5.69
Septem	1	3	1	5	4	6	4	6	.46	3.83
Octo.	4	12	2		1	5	2	4	.60	1.84
Novem	1	3	2		2	8	2	12	.68	.60
Decem	1	5	1	9	1	8	2	4	.70	2.32
	22	57	17	36	18	93	31	90		24.25

	N.	N.E.	E.	S. E.	S.	SW	W.	NW	Barom.	Rain.
1738.									0	in. dec.
Janu.				1		16	6	8	29.70	1.70
Febru.	2	4		5	1	7	1	8	.61	.81
March		4			3	11	1	12	.46	.99
April	3	7		4	3	8		5	.53	1.31
May	1	5		6	3	11	3	2	.52	1.90
June	2	1		1	1	12	3	9	.50	3.42
July	1	2	3	3	1	12	2	7	.72	1.17
August	1	2			2	12	5	9	.60	1.57
Septem	1	9	1	1		11	3	3	.65	1.75
Octo.	1	1	2	4	2	9	1	7	.52	1.80
Novem	2	2	1	4	3	10		5	.67	.71
Decem	2	6			2	13	1	7	.58	1.22
	16	43	7	29	21	132	26	82		18.35
1739.										
Janu.				2	2	22		5	29.45	2.37
Febru.	1	1			2	15	1	8	.60	3.11
March	1	10		1		4	1	13	.48	2.27
April	1	6	3	3	2	5		10	.34	1.17
May	1	10	1	2	3	11	1	2	.60	1.93
June		2	1	2	2	18	2	1	.56	1.54
July		7	1	1		13	2	7	.67	2.67
August	2	1	1	3	2	9	1	11	.61	1.57
Septem		2	5	6	3	8		6	.49	.85
Octo.		17	2	5	1	5	1		.71	.78
Novem	1	2	4	6	1	6	3	7	.32	1.70
Decem	2	5	8	3	1	9		3	.65	1.88
	9	63	26	34	19	125	12	73		22.84
									Rain.	
Janu.	18	27	21	29	26	113	29	75	13.23	Total of the Winds and Quantity of Rain in each Year during the 11 Years.
Febru.	19	25	12	22	18	113	27	73	18.07	
March	20	51	28	29	24	77	30	79	18.23	
April	27	71	30	28	23	67	26	53	12.98	
May	43	64	26	38	27	69	28	44	20.88	
June	27	37	18	32	17	90	32	66	22.08	
July	18	37	15	27	25	94	47	73	23.24	
August	23	31	23	19	28	101	32	75	28.96	
Septem	14	32	27	41	21	98	35	58	24.35	
Octo.	11	54	41	46	20	85	25	44	22.39	
Novem	14	35	18	33	24	83	32	83	15.51	
Decem	15	28	32	32	23	126	24	61	22.51	
	249	492	291	376	276	1116	367	784	242.43	

The shepherd's observation of the manner in which the winds settle in the east or south-west, is particularly worthy the farmer's attention, because it will lead him to most useful foreknowledge. It is however proper to observe, that as great part of England is an open country, at least free from high hills, the winds and weather are more regular there, than in mountainous countries, or where the coast is intersected by arms of the sea. The shepherd's remark made in the middle of that delightful plain which constitutes the greatest part of England, will therefore not hold so true in other places differently situated.

When he tells us, that in eight years we have as many wet as dry, he does not ascertain what winds bring rain or fair weather; and, as Mr. Worlidge observes, "that wind which brings rain to one part of the island, may not to another: for on whichever coast the sea is nearest, the wind more frequently brings rain to that place, than to another where the sea is more remote. Therefore," says he, "I desire all such as expect any success to

their observations, that they quadrate the rules to the place where they live, and not trust to the observations of other places."

Southerly and westerly winds prove generally rainy in this island, there being so great an extent of sea to the south-west: yet places far distant from that sea, or which are screened from it by high mountains, have fair weather; as is the case on the north-east coast of Scotland, where the vapours are intercepted by the Grampian hills. The easterly winds, coming to the south part of the island over a narrow tract of sea, are generally fair, except when in winter they bring on that dark, heavy sky, described by Dr. Derham. They are extremely sharp and cold in the winter, coming from a frozen continent; but if inclined to the south, are hot and dry in the summer, as coming from the continent then heated by the sun. The easterly winds crossing a much wider sea in their passage to Scotland, prove generally rainy all along the east of that country; but fair on the west. We may easily conceive that the air, in crossing the German

ocean, may take up water enough to cause this rain, by it's faculty of attracting water, before mentioned.

A wind blowing from the sea is observed to be always moist; cold in summer, and warm in winter, unless the sea be frozen up: (*i. e.* the temperature of wind blowing over water, is more equal than that of wind blowing over land :) and winds blowing from large continents are dry, warm in summer, and cold in winter. If the frost is 'so great as to freeze the vapour as it rises from the sea, it must feel extremely sharp and cold to our bodies; though by the thermometer the cold may be the same as in lofty situations to which such heavy vapours seldom ascend in winter. This frozen vapour acting as so many sharp points, may be easily conceived to produce those mischievous effects on tender vegetables, which I noticed in a former work*, as one of the disadvantages of low situations.

A remarkable proof of this (as I likewise mentioned in the same place) occurred on the first settlement of the English in North-

* System of Husbandry, vol. 3, p. 461.

America. They imitated our custom of building in vallies, and near rivers: but experience soon taught them, that such places are more subject to the suffocating, sultry heat of the summer; and, what they little expected, to a greater severity of frost in the winter, than rising grounds generally are. I have been informed by one of the most curious and intelligent observers of the laws of nature, that the cold there, in their hardest frosts, is found to be so severe in the vallies, to a certain height, as sometimes to kill every tender vegetable, while those on the higher grounds escape. This generally takes place to a regular, determined height, above which the Americans now build their houses. — If I might offer a conjecture concerning the cause of this, I should say, that the effect of the cold seems to be limited to the height to which the great moisture of the air rises at that season. In the hard winter of 1739-40 the same happened in this kingdom, when the frost was much less severe in it's effect in the hilly countries, than in the low lands.

Lord Bacon observes, that, “ when the wind changes conformable to the motion of the sun, that is from east to south, from south to west, &c. it seldom goes back; or if it does, it is only for a short time: but if it moves in a contrary direction, *viz.* from east to north, from north to west, it generally returns to the former point, at least before it has gone quite through the circle. When winds continue to vary for a few hours, as if it were to try in what point they should settle, and afterwards begin to blow constant, they continue for many days. If the south wind begins to blow for two or three days, the north wind will blow suddenly after it; but if the north wind blows for the same number of days, the south will not rise till after the east has blown a while. Whatever wind begins to blow in the morning, usually continues longer than that which rises in the evening.”

Mr. Worlidge observes, that “ if the wind be east or north-east in the fore part of the summer, the weather is likely to continue dry: and if westward toward the end of the

summer, then will it also continue dry. If in great rains the winds rise or fall, it signifies that the rain will forthwith cease. If the colours of the rain-bow tend more to red than any other colour, wind follows; if green or blue predominate, then rain."

The most considerable thing with regard to the barometer, which marks the weight of the air, is, as M. de la Hire has observed in the Memoirs of the Royal Academy of Sciences for the year 1704, the changes which happen to it in two or three days, wherein we often see it descend, and rise more than an inch. This shews that there must be great variations in a little time in the height of the atmosphere. "In order to account for these different weights of the air, says he, it does not appear to me probable to suppose, as some philosophers do, different liquids, and of different gravities, on the surface of the earth, which are sometimes carried one way, and sometimes another; for we know by observation, that the air is commonly lightest, when most loaded with vapour.

"I think one may very well explain, in

the following manner, all that we observe of the weight of the air or atmosphere, in all it's circumstances. We know, by very exact observations, that the barometer rises in general less high between the tropics than in the northern countries; from whence it may be conjectured, that the figure of the atmosphere is an oblong spheroid, whose axis corresponds with that of the earth. Now, as wherever there is air, there may be winds; if the same wind reigns through the whole mass of air, and comes from the south, it will necessarily lower the height of the atmosphere in those countries; and on the contrary, if it comes from the north, it will raise it. But moreover, as winds from the south bring us rain, it will follow, that it should rain when the air will appear lighter: the entire contrary must happen from the opposite quarter.

“ This is, in general, what must follow from the foregoing supposition: but if the south wind reigns only near the surface of the earth, and there be a northerly wind in the superior region, it may rain although the

air appear very heavy ; and by a contrary reason, it may be very fine weather with a northerly wind, and the barometer extremely low ; for we can only observe the winds that are near the surface of the earth."

That different winds do rule in the air at the same time, and sometimes entirely opposite ones, is frequently evident from the driving of the clouds in different directions. It may happen that the combat of these different winds may occasion storms and hurricanes, which Virgil alludes to in his description of a storm, when he says,

" South, east, and west with mix'd confusion
roar."

ÆNEID. B. I.

The same prince of poets has elegantly shewn his skill in philosophy, and at the same time in physic, with regard to the influence of the air on animal bodies, in the following lines ; which confirm what was before noticed in Sect. II, and might indeed properly have been added thereto :

" But with the changeful temper of the skies,
" As rains condense, and sun-shine rarefies ;
" So turn the species in their alter'd minds,
" Compos'd by calms, and discompos'd by winds :

“ From hence proceeds the bird’s harmonious voice,
 “ From hence the crows exult, and frisking lambs
 rejoice. GEORG. I.

“ I am persuaded, says M. de la Hire,* that fair or rainy weather do not depend on the weight or lightness of the air; but that they are occasioned solely by the winds: I do not mean the wind in general, but such winds as come from a distance from the north and south, and occupy the greatest part of the atmosphere, and not such as are produced near the surface of the earth: for the sun raising more vapours in the southern countries than in the northern, the southern winds most commonly give more rain than the northern: and as we know by all the observations which have been made towards the north, that the atmosphere there is higher than towards the equator, it must happen, that the winds which shall blow from the north will cause the atmosphere to rise in our temperate zone more than usual; and by consequence the mercury will be

* *Memoires de l’Academie Royale des Sciences, pour l’an 1715.*

raised by the greater weight of the atmosphere; and the air will become serene by such a wind. The contrary must happen with regard to the winds which shall blow from the south upon these countries.

“One may consider the heat of 1718, continues he,* as the greatest we had observed at Paris: not but that the thermometer had in like manner risen to 82 degrees in the years 1706, 1707 and 1709; but then it rose to that point only once in each of these years; whereas in 1718 it rose to that height four different days, viz. August 11th, 21st, 22d, 23d; and it is that continued heat, although of the same degree, which makes us feel it's power. The thermometer rose at sun-rising to 70 degrees on the 22d.

“Some have imagined † that the greater or less heat, which glows in the same season in different years, may arise from the spots that are observed at the same time in the

† *Memoires de l'Academie Royale des Sciences, pour l'an 1718.*

* *Ibid. pour l'an 1719.*

sun; and as when that planet is spotted it does not throw forth so great a number of rays to the earth, that the heats must of consequence be less than when it has no spots. But the experience we have had the two preceding years shews, that this explanation is not sufficient: for during these years, 1718 and 1719, we seldom saw the sun without spots; and sometimes there were so great a number of them at once, that we counted nine or ten at the same time, the greatest part of which were very large: yet notwithstanding so many spots during these two last years, the heat was remarkably violent, and of long continuance; for in the last of these years it continued from the beginning of June to the middle of September. Thus it appears that the different temperature of the same season in different years, cannot be attributed to the spots of the sun, but may more probably be owing to the different exhalations of the earth, sometimes colder, sometimes hotter, and to the diversity of winds which rule in the same seasons, and which have not, so far as we know at present, any regular periods in our climates."

SECTION VIII.

Prognostics of the Weather taken from the Changes of the Seasons.

AS every year, and the various seasons of each year, have a peculiar character by which they may be distinguished, as to heat, cold, drought, rain, &c. and as the quality of the seasons has a most sensible effect on the productions of the earth, it is evident, that it must be of the greatest advantage to the farmer to be able to foresee the nature of the ensuing season, because he can thereby suit the culture of his grounds, and his crops, to the weather expected.

The antients had certainly arrived at a more perfect knowledge in this article, than we are possessed of. They, observing that the weather of each season set in at a stated time, imputed it's quality to the influence of certain stars which happened then to be conspicuous. In after ages, monks and designing priests, desirous to ascribe every merit

to their saints, transferred the supposed influence of the stars to the saints whose commemoration happened near the same time. The moderns, being sensible that the inconceivable distance of the fixed stars, and the smallness of our nearest planets, must render their influence on our atmosphere of no effect, and having but little faith in saints, have, perhaps injudiciously, rejected the observations of the antients, without considering, that the facts might have been discovered first, and the stars and saints only called in to account for them. The antients acted more rationally than the monks, in not fixing these changes of the weather to particular days, but only to a stated time of the year, as appears from Pliny and other writers on this subject.

By the help of the barometer, we seem to regain that foreknowledge of the weather which still resides in brutes, and which we forfeited, both by not continuing in the open air as they generally do, and by our intemperance's lessening our sensibility of external objects.

Authors are generally agreed, that the rising of the mercury forebodes fair after foul, with easterly or north-easterly winds ; and that it's falling portends southerly or westerly winds, either stormy, or with rain.

The more northerly places experience greater alterations in the barometer, than the more southerly. Within the tropics, or near them, there is little or no variation in the height of the mercury.

In serene settled weather, the barometer is high. Other things equal, the greatest heights of the mercury are upon easterly and north-easterly winds. During great winds, though unaccompanied with rain, the mercury is lowest of all, especially if the wind be southerly. After great storms of wind, when the mercury has been low, it generally rises again. Other things equal, the mercury is higher in cold weather than in warm, and usually more so in the morning and evening, than at mid-day.

When the character of the season is once ascertained, the returns of rain, or fair weather, may be judged of with some degree of

certainty in some years, though but scarcely to be guessed at in others, by means of the barometer; for, in general, we may expect, that when the mercury rises high, a few days of fair weather will follow. If the mercury falls again in two or three days, but soon rises high, without much rain, we may expect fair weather for several days; and in this case, the clearest days are after the mercury begins to fall. In like manner, if the mercury falls very low, with much rain; rises soon, but falls again in a day or two, with rain; a continuance of bad weather may be feared. If the second fall does not bring much rain, but the mercury rises gradually pretty high, it prognosticates settled good weather of some continuance. When a heavy rain has fallen upon the mercury's sinking, and it's continuing steadily low, the weather is sometimes fair, and promises well; but no prudent man should trust to such appearances. There is indeed a caution of this kind which the poorest may profit by. When the mercury rises high in the barometer, the air sucks up all the moisture on the surface of the earth,

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even though the sky be overcast, and that is a sure sign of fair weather: but if the earth continue moist, and water stands in shallow places, no trust should be put in the clearest sky, for in this case it is deceitful.

Towards the end of March, or more generally in the beginning of April, the barometer sinks very low, with bad weather; after which, it seldom falls lower than $29^{\circ} 5'$, till the latter end of September or October, when the quicksilver falls again low, with stormy winds, for then the winter constitution of the air takes place: from October to April, the great falls of the barometer are from $29^{\circ} 5'$ to $28^{\circ} 5'$; sometimes lower: whereas during the summer constitution of the air, the quicksilver seldom falls lower than $29^{\circ} 5'$. It therefore follows from hence, that a fall of one tenth of an inch, during the summer, is as sure an indication of rain, as a fall of between two and three tenths is in the winter.

It must, however, be observed, that these heights of the barometer hold only in places nearly on a level with the sea; for experi-

ments have taught us, that for every eighty feet of nearly perpendicular height that the barometer is placed above the level of the sea, the quicksilver sinks one tenth of an inch : now by an accurate comparifon between the motion of the barometer in inland and higher places, with it's motion in a place on a level with the sea, the heights of these inland places may be pretty nearly ascertained ; and observations must determine the heights of the quicksilver, which in each place denote either fair or foul weather.

In all places nearly on a level with the sea, rain may be expected when the quicksilver falls below thirty inches. This points out one cause of the more frequent rains in lofty situations, than in low open countries. Thus double the quantity of rain falls at Townly-hall in Lancashire, that does at London.

Very heavy thunder storms happen, without sensibly affecting the barometer ; and in this case the storm seldom reaches far. When a thunder storm is attended with a fall of the barometer, it's effect is much more extensive.

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And here I must mention an observation which has often been verified by a friend of mine who keeps a regular journal of the weather, viz. that when the quicksilver falls very low, and the weather continues mild and the wind moderate, there is at the same time a violent storm in some distant place: this accounts for a false prognostic, often unjustly laid to the charge of the barometer; and was signally instanced in the remarkably great fall of the barometer on the 22d of November last (1768), when the quicksilver fell in the night to nearly $28^{\circ} 3$ inches. The weather here (in London) was then mild, with little rain, and the wind moderate; and accounts have since been received of a violent storm of wind at the same time in the Atlantic ocean, west of England and Ireland, which extended to the English and St. George's channels.

That valuable friend of mankind, Benjamin Franklin, LL. D. F. R. S, and honorary member of the Royal Academy of Sciences at Paris, whose piercing eye and comprehensive judgment let nothing escape him,

has, in one of his philosophical letters*, by a single instance, accounted more rationally for the causes and progress of storms, than all who have gone before him have done; with this farther advantage, that his reasoning is confirmed by observation.

“ I think, says he, that our *north-east storms* in North-America begin first, in point of time, in the *south-west* parts: that is to say, the air in Florida and Georgia, the farthest of our colonies to the *south-west*, begins to move *south-westerly* before the air of Carolina, which is the next colony *north-eastward*; the air of Carolina has the same motion as the air of Virginia, which is still more *north-eastward*; and so on *north-easterly* through Pensilvania, New-York, New-England, &c. quite to Newfoundland.

“ These *north-east* storms are generally very violent, continue sometimes two or three days, and often do considerable damage in the harbours along the coast. They are attended with thick clouds and rain.

* Letter XXXVI.

“ What first gave me this idea, was the following circumstance. About twenty years ago, a few more or less, I cannot from my memory be certain, we were to have an eclipse of the moon at Philadelphia, on a Friday evening, about nine o'clock. I intended to observe it, but was prevented by a *north-east* storm, which came on about seven, with thick clouds as usual, that quite obscured the whole hemisphere. Yet when the post brought us the Boston news-paper, giving an account of the effects of the same storm in those parts, I found the beginning of the eclipse had been well observed there, though Boston lies *north-east* of Philadelphia about four hundred miles. This puzzled me, because the storm began with us so soon as to prevent any observation, and being a *north-east* storm, I imagined it must have begun rather sooner in places farther to the *north-eastward*, than it did at Philadelphia. I therefore mentioned it in a letter to my brother who lived at Boston; and he informed me the storm did not begin with them till near eleven o'clock, so that they had a good ob-

servation of the eclipse : and upon comparing all the other accounts I received from the several colonies, of the time of the beginning of the same storm, and since that of other storms of the same kind, I found the beginning to be always later the farther *north-eastward*. I have not my notes with me here in England, and cannot, from memory, say the proportion of time to distance ; but I think it is about an hour to every hundred miles.

“ From thence I formed an idea of the cause of these storms, which I would explain by a familiar instance or two—Suppose a long canal of water stopped at the end by a gate. The water is quite at rest till the gate is open, then it begins to move out through the gate ; the water next the gate is first in motion, and moves towards the gate ; the water next to that first water moves next, and so on successively, till the water at the head of the canal is in motion, which is last of all. In this case all the water moves indeed towards the gate, but the successive times of beginning motion are the contrary way, viz.

from the gate backwards to the head of the canal.—Again, suppose the air in a chamber at rest, no current through the room till you make a fire in the chimney. Immediately the air in the chimney being rarefied by the fire, rises; the air next the chimney flows in to supply it's place, moving towards the chimney; and, in consequence, the rest of the air successively, quite back to the door. Thus, to produce our *north-east* storms, I suppose some great heat and rarefaction of the air in or about the gulph of Mexico; the air then rising has it's place supplied by the next more northern, cooler, and therefore denser and heavier air; that, being in motion, is followed by the next more northern air, &c. &c. in a successive current, to which current our coast and inland ridge of mountains give the direction of *north-east*, as they lie *north-east* and *south-west*.

“ This I offer only as an hypothesis to account for this particular fact; and, perhaps, on farther examination, a better and truer may be found. I do not suppose all storms generated in the same manner. The north-

west thunder-gusts in America, I know are not."

If accounts from different parts of Europe were compared on the above-mentioned very great fall of the barometer on the 22d of November, 1768, with the same accuracy as was done in America by the judicious Dr. Franklin, the origin and progress of storms which probably accompanied this fall, might be traced. To our woeful experience, we in England long felt the consequences of the effects which attended the subsequent fall of the barometer, from the 30th of November to the 3d of December of the same year, in the deluges of rain which fell almost universally.

Heretofore, the general idea was, that the progress of the storm was to be estimated by the celerity of the wind: and hence a velocity was sometimes assigned to the wind, which perhaps scarcely ever existed; as Dr. Franklin's observations have fully proved.

Certain it is, that the character of the season is less steady at the equinoxes, and more regular during the intermediate months. The

advocates for the celestial influence on the atmosphere think, that the changes of the weather are in a great measure regulated by the moon's place in the zodiac, or by her situation with respect to the sun : but observation has not yet ascertained any thing on this head.

Whatever the causes of the changes in the weather, or, what is nearly the same, in the motion of the quicksilver in the barometer, may be, whether celestial or terrestrial, their effects are generally felt over a considerable extent of country at the same time. Every one may be assured of this, by comparing accounts kept at distant places, of the play of the barometer. They will find, that the great falls or rises of the mercury happen nearly at the same time, in almost all the northern countries of Europe; I say nearly, because a difference will be observed, usually attending the direction of the wind. If these causes were celestial, the effects would be universally the same, except where varied by the situations with regard to seas, mountains, &c. As this is not the case, the

causes must probably be sought for in the earth. This opinion is favoured by the observations of miners, who have been generally sensible of some prognosticating circumstances in mines, before any change of the weather appeared in the air.

The hurricanes which desolate Saxony are all formed in, or at least all proceed from the mines in the mountains of Freyberg, situated south-west of Dresden and south-east of Leipzig; as is remarked by Count Algarotti, in his 8th letter to Lord Hervey.*

Even the limited fore-knowledge above pointed out would be of great use to the husbandman, if duly attended to; for instance, at the time of hay-making, when it would be of considerable advantage for him to be able to judge whether he may cut his grass with a prospect of fair weather to dry it; and at all times of the year, in order to his getting ready every thing necessary for carrying into execution the works proper for each season.

Besides a barometer, for the purposes

* See ALGAROTTI's *Letters upon Russia*.

above-mentioned, it is likewise necessary for whoever would keep an exact register of the weather, to be also provided with a thermometer, in order to notice and mark down the changes which happen in the heat or temperature of the air. This is not a matter of curiosity only, but of real utility: for, from the changes in the temperature of the air, which attend every change of weather, some happy genius may possibly discover causes of the alterations in the degrees of heat, which may lead to a more satisfactory account than any we yet have, of the changes of the year.

Every change of the weather is attended with a change in the temperature of the air, which a thermometer placed in the open air, will point out, sometimes before any alteration is perceived in the barometer. This change in the temperature of the air arises from causes yet unknown to us, and of which the discovery should be the object of the curious observer. The early intimations of changes in the weather given to miners, when working deep under ground, makes it probable, that the temperature of the air de-

pende much on what passes beneath the surface of the earth ; and this is confirmed by every general thaw, in which the ice is as much melted in the under part (and thereby loosened from the earth,) as it is on the surface. The uncommon degree of heat which sometimes happens in the winter and early in spring, must likewise be occasioned by somewhat proceeding from the earth ; as does also, probably, the sultry heat frequent in the summer, and which is generally the forerunner of thunder.

The knowledge of the exact degree of cold in the winter, is of consequence to the farmer ; for it has been observed, that when the frost is so keen as that the thermometer sinks fourteen degrees on Fahrenheit's scale, most succulent vegetables are thereby destroyed, such as almost all the cabbage or kale tribe, turneps, &c. for their juices being then frozen hard, their vessels are thereby torn asunder or split, so that when the thaw comes on, the whole substance, for instance of turneps and apples, runs into a putrid mass. In this case, the most likely

way to prevent their being lost, or at least to prevent a total loss of them, is to immerse what is so frozen in cold water, till the frost is extracted by the water: the loss is thereby delayed a little, and indeed only delayed; for what is not used very speedily, will soon putrefy, notwithstanding this care. The knowledge of this consequence of so severe a frost, may however put the farmer on some method of repairing the loss he sees coming on. Time may point out other useful observations, which may arise from the knowledge of what may be discovered from the changes in the thermometer.

A strict observer of the weather may also, rightly, wish to keep an account of the degree of moisture of the air, or at least of its sensible variations. There are several means of doing this; for whatever body either swells or shrinks by moisture or dryness, is capable of being formed into an hygrometer: such are most kinds of wood, especially white wood, as poplar, birch, plane, ash; even deal will do. On this principle it is, that wedges of well-dried wood are made use of

to cleave or raise rocks or stones: for as the moisture of dew, rain, or water applied to them, enters into them, they swell and overcome an inconceivable resistance. Ropes or strings made of hemp, flax, or any other vegetable substance, become also hygrometers. This is well known to sailors, who, according to the dryness or moisture of the air, find the shrouds of their vessels slack or tightened, so as, in the latter case, to be in danger of breaking. The use that was made of water applied to the tackle employed in raising the famous obelisk at Rome, is well known.

Stretch a cord or fiddle-string, fastened at one end over a pulley, and to the other end tie a weight: this will rise or fall as the air becomes dry or moist, and consequently be an hygrometer.

Animal substances twisted and dried answer the same purposes, as fiddlers often find to their cost, when the too great moisture of the air breaks their strings.

A great misfortune attending the use of all these substances is, that by use they become sensibly less and less accurate, so as at length

not to undergo any visible alteration from the different states of the air, in regard to dryness or moisture. On this account a sponge may be preferred, as being less liable to be so changed. To prepare the sponge, first wash it in water, and when dry, wash it again in water wherein Sal Ammoniac, or salt of Tartar, has been dissolved; and let it dry again. Now, if the air becomes moist, the sponge will grow heavier; and if dry, it will become lighter.

Oil of vitriol is found to grow sensibly lighter or heavier in proportion to the lesser or greater quantity of moisture it imbibes from the air. The alteration is so great, that it has been known to change it's weight from three drams to nine. The other acid oils, or, as they are usually called, spirits, or oil of tartar *per deliquium*, may be substituted in lieu of the oil of vitriol.

In order to make an hygrometer with these bodies which acquire or lose weight in the air, place such a substance in a scale on the end of a steel-yard, with a counterpoise which shall keep it in equilibrio in fair weather:

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the other end of the steel-yard, rising or falling, and pointing to a graduated index, will shew the changes. Whoever would be more accurately informed, may consult the Philosophical Transactions.

It was observed by the antients, that the early or late arrival of birds of passage indicates the nature of the approaching season; whether it will be early or late, severe or mild. In the same manner, Linnæus advises husbandmen to mark the first signs of a beginning vegetation of such plants as grow wild, and are natives of the climate; for that they, by their early or late shooting, inform the attentive farmer of the approach of spring. He advises the husbandman to extend these remarks to different plants, whose vegetation has been observed to coincide with the times of sowing particular seeds. These are objects highly worthy of a place in such a journal of the weather as there still remains too much room to wish for; because facts of this kind would remain, from year to year, a register of the state of every article any way relative to rural oeconomics: and upon this

principle it is, that M. Duhamel has very judiciously added to his journal of the weather, an account of the state of all the vegetables and animals useful in a farm; or, which is the same, of the effects of the weather on them.

The only method by which the changes of the weather can be traced with precision, undoubtedly is to keep regular registers of the weather, and mark every appearance in the heavens or on the earth, which may tend to point out the approaching seasons. The very business of the farmer necessarily keeping him much in the open air, would render this an easy task to him; and his progress in fixing facts, and in drawing judicious conclusions from them, would perhaps be much more speedy and successful than he himself might expect.

Having but few rules relative to the Changes of the Seasons, founded on observations, unless the shepherd of Banbury's be reckoned such, I shall endeavour to collect the most rational that I have met with, and accordingly begin with his

24th Rule. If the last eighteen days of Fe-

bruary and the first ten days of *March** be for the most part *rainy*, then *the spring and summer quarters will be so too* : and I never knew a great drought but it entered in at that season.

25th Rule. If the latter end of *October* and beginning of *November* be for the most part *warm and rainy*, then *January and February are like to be frosty and cold*, except after a very dry summer.

26th Rule. If *October* and *November* be *snow and frost*, then *January and February are like to be open and mild*.

Mr. Claridge gives us the following observations made by our forefathers ;

Janiveer freeze the pot by the fire.

If the grafs grow in *Janiveer*,

It grows the worse for't all the year.

The Welchman had rather see his dam on the bier,

Than see a fair *Februeer*.

March wind and *May* sun

Makes cloaths white, and maids dun.

When *April* blows his horn,

It's good both for hay and corn.

* It is to be observed, that the shepherd reckons by the old stile.

An *April* flood
Carries away the frog and her brood.
A cold *May* and a windy
Makes a full barn and a findy.
A *May* flood never did good.
A swarm of bees in *May*
Is worth a load of hay.
But a swarm in *July*
Is not worth a fly.

The following rules are laid down by Lord Bacon :

If the wainscot or walls that used to sweat be drier than usual, in the beginning of winter, or the eaves of houses drop more slowly than ordinary, it portends a hard and frosty winter : for it shews an inclination in the air to dry weather, which, in winter, is always joined with frost.

Generally, a moist and cool summer portends a hard winter.

A hot and dry summer and autumn, especially if the heat and drought extend far into September, portend an open beginning of winter, and cold to succeed towards the latter part of the winter, and beginning of spring.

A warm and open winter portends a hot and dry summer ; for the vapours disperse into the winter showers : whereas cold and frost keep them in, and convey them to the late spring and following summer.

Birds that change countries at certain seasons, if they come early, shew the temper of the weather, according to the country whence they came : as, in the winter, wood-cocks, fieldfares, snipes, &c. if they come early, shew a cold winter ; and the cuckoos, if they come early, shew a hot summer to follow.

A serene autumn denotes a windy winter ; a windy winter, a rainy spring ; a rainy spring, a serene summer ; a serene summer, a windy autumn : so that the air, on a balance, is seldom debtor to itself ; nor do the seasons succeed each other in the same tenor for two years together.

Mr. Worlidge remarks, that

If at the beginning of the winter the south-wind blow, and then the north, it is like to be a cold winter : but if the north-wind first blow, and then the south, it will be a warm and mild winter.

If the oak bear much mast, it foreshews a long and hard winter. The same has been observed of hips and haws.

If broom be full of flowers, it usually signifieth plenty.

Mark well the flow'ring almonds in the wood;
If od'rous blooms the bearing branches load,
The glebe will answer to the sylvan reign,
Great heats will follow, and large crops of grain.
But if a wood of leaves o'er shade the tree,
Such and so barren will the harvest be.
In vain the hind shall vex the threshing floor,
For empty chaff and straw will be thy store.

.VIRGIL.

This observation, says Mr. Worlidge, hath proved for the most part true for several years now past; as in 1673 and 1674 there were but few nuts, and cold wet harvests: in 1675 and 1676, were plenty of nuts, and heavy and dry harvests; but more especially in 1676 was a great shew of nuts, and a very hot and dry harvest succeeded.

The excessive cold of this winter, says M. de la Hire, speaking of that of the year

1709*, in which the thermometer sunk to 9 degrés on the 10th of January, came on without any considerable wind, and what little wind there was, came from the south; and when the wind increased and turned to the north, the cold diminished. The mountains of Auvergne, which are to the south of Paris, were at that time all covered with snow.

Another surprising thing was, that notwithstanding the violence of the cold, the river Seine was not entirely frozen over at Paris, but the middle of it's current continued free, except that there floated in it large pieces of ice: yet in less rigorous winters it hath been often so frozen, that carriages could pass over it. The cold of this winter was so sudden, that the ice at the edges, and in the lesser rivers, was so fast bound at once, that few flakes of it broke off, and they generally fell in the middle of the stream; so that the violence of the frost was in part the cause that the river Seine was not frozen over.

* *Memoires de l'Academie Royale des Sciences, pour l'an 1709.*

Though the year 1714 was dry, the rain being only 14 inches and $\frac{3}{4}$; yet as there were many thick fogs during the whole of that year, the harvest was very plentiful, and the fruits were extremely well ripened. Fogs are much more serviceable than rains, for the nourishment of plants.*

Before I conclude, it may not be amiss to observe, how different the weather sometimes is in climates not very distant. In the year 1751, we had a very rainy summer throughout England, and the barometer was very unsettled. At the same time an extraordinary drought prevailed in Italy. ‡

At Brest, in the year 1725, the barometer seemed fixed at $26^{\circ} 4'$ from the 2d of February to the 1st of September, when it rose suddenly to 28° . The rains were excessive; a perfect deluge drowned every thing thereabouts. At the same time the weather was, as usual, changeable at Paris.†

* *Memoires de l'Academie Royale des Sciences, pour l'an 1714.*

‡ Borlase's Natural History of Cornwall, p. 20.

† *De la Hire, ubi supra, pour l'an 1725.*

Though the year 1711 was dry, the rain
 fell only 14 1/2 inches; yet as there were
 only three 1/2 inches of snow, the whole of that
 year the ground was very dry, and the
 crops were very poor. In 1712, however,
 it was more plentiful than in 1711, for the
 amount of rain was 17 1/2 inches.

As the 17th century is now too early to
 give, how different the weather was in
 a century not very distant. In the year
 1711 we had a very rainy summer, though
 the ground and the bottom was very
 dry. At the same time an extraordinary
 quantity of rain fell.



At the same time an extraordinary
 quantity of rain fell.

At the same time an extraordinary
 quantity of rain fell.

At the same time an extraordinary
 quantity of rain fell.

At the same time an extraordinary
 quantity of rain fell.

A P P E N D I X.

A B S T R A C T

OF THE

METEOROLOGICAL OBSERVATIONS

MADE BY THE

Oeconomical Society of Berne,

For the Year 1766.



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A P P E N D I X.

J A N U A R Y.

THIS month was exceedingly cold and dry ; the barometer as high as it was ever seen ; the wind constantly N. and N. E. attended with very little snow. No rain at Berne. Our lakes were frozen so hard, that they bore every kind of carriage without risk, the ice being six inches thick.

The cold penetrated to such a degree, that the wine was frozen in several vaults ; and in our fields and vineyards, the earth was frozen three feet deep. Many vines, especially the old ones, and even chefnut trees and oaks, were split by the severity of the frost, particularly on the heights. Where a good deal of snow had fallen, the springs were not frozen ; but in other places they were dried up, by which means the water of the river Aar was extraordinary low.

In the beginning of the month, the frost was exceedingly severe ; about the middle, it abated ; but towards the end, it set in again as hard as at first. The sky was cloudy

during the severity of the cold, and there were frequent fogs.

The crops sown in the autumn, especially in moist soils, made a poor appearance. The frost penetrated least deep in the grounds on which scourings of ponds, &c. or marle had been laid; these substances preventing the soil's being frozen so hard as it would otherwise have been.

The pastures which had been watered were one continued sheet of ice, and it was feared they would be greatly damaged by it.

Pleurisies were very frequent during this month. In some places dysenteries began. Some were attacked with apoplexies, violent coughs, rheums, and other disorders of the season. The cattle continued very healthy, except the sheep, many of which were seized with inflammations on the lungs.

F E B R U A R Y.

THE beginning and end of this month were very cold: the middle of it was somewhat milder. The frost penetrated so



deep into the houses, that the carrots, potatoes, and other plants of this kind were frozen in most of our cellars, and in holes dug in the earth for sheltering them.

The barometer varied greatly, being sometimes very high, and sometimes very low.

The wind blew mostly from the north, and rarely from S. or W. No rain.

The ground under corn looked like a fallow, the blades being quite yellow. It was not till the end of the month that they began to turn green. The great quantities of snow deeply frozen in the vallies between the mountains, and in shaded places, threatened much danger to the corn.

The damage done to the vines could not be judged of this month, but it was plain they had suffered very much; for in places where some began to prune them, their wood was yellow and quite dry. The earth could not yet be opened about them.

Some mild days melted the greatest part of the ice that covered the pastures, and in the places where that happened they appeared pretty green.

Trees suffered exceedingly from the cold, great numbers of them being split. Most of the laurels, fig-trees, and rosemary bushes, perished, and scarce any thing escaped in the gardens.

Notwithstanding the rigour of the weather, storks appeared towards the latter end of the month, but somewhat later than usual.

The bees did not escape the severity of the cold, which killed great numbers of them. They began to go out on the 17th, and their hives were cleaned.

Putrid fevers, pleurisies, rheums, and inflammations in the throat, prevailed. Few children escaped the measles. Many sheep still died.

M A R C H.

THE beginning and end of this month were cold; the latter, especially, was rainy and stormy: the middle of it was pretty mild and agreeable. The snow and ice melted; though it snowed a little towards the end of the month. The lake of Bienné

was so strongly frozen on the first of March, that a carpenter built a spacious booth a considerable way out upon the ice, and made a very great fire in it. The ice did not become loose on the sides of the lake till the middle of the month, and it continued in one entire piece in the middle till the 23d and 24th.

The wind blew generally from the N. E. and N. W. Rain fell to the depth of $\frac{1}{2}$ an inch.

Contrary to all expectation, the young corn looked well. The light and wet soils only had suffered. Our husbandmen began to sow their spring crops; but the season was so cold and wet, that they were obliged to give it up.

The hurt which the vines had sustained from the frost appeared now more and more: almost all those that were six or seven years old, perished. In general, the vines in the plains and light soils suffered more than those on hanging grounds and strong soils. The vine-yards facing the North suffered least. The vines bearing red grapes perished most. Few were yet laid down, the effects

of so doing being still very uncertain. Towards the end of the month the pruned vines began to weep, and upon cutting them anew, the wound was of the colour of a rotten apple. The buds fell off in powder with the slightest touch.

The pastures remained covered with ice till the middle of the month, when the earth was thawed; but there was yet no verdure even in places free from ice. The first violets were seen on the 8th.

The gardens, in which scarce a plant had escaped the severity of the cold, began to be put in order in the beginning of this month.

The cold nights kept back the bloom of the trees. In the second week the apricots began to blossom; but they suffered much from the cold. Of all the fruit trees, the figs suffered most from the cold. The other trees were full of blossoms. The service trees, which usually blossom in February, were not in bloom this year till the end of this month.

Most of the bees perished; and we were

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obliged to feed those that remained, to preserve them from the same fate.

Putrid fevers and pleurifies carried off many people ; and the sheep still continued to die.

A P R I L.

THE weather was dry and fine during this month, though the nights were a little cold, with a few hoar-frosts. There was frequent thunder, accompanied with cold rains. The N. and N. E. winds prevailed most.

The barometer varied but little.

The winter corn in general looked well, and the spring corn came up very well every where, the season being very favourable.

The pastures did not recover their verdure till the end of the month. The frost had destroyed the turf in many places. Towards the end of the month, dews and mild rains brought the grass on very quick.

This month shewed us how much the

vines had suffered. Half of them had perished; in some places scarce one remained out of forty; and what rendered this loss the more grievous, was, that the best were those which suffered most. Those which were not destroyed, began to bud about the middle of this month; and the roots of those whose branches had been killed made shoots, from which, however, no fruit could be expected, till after they should be pruned and laid down. The vines were dug round from the beginning of this month.

The seeds sown in gardens rose but slowly, owing to cold winds; and flowers also felt the unkindly season.

The trees blossomed surprizingly well. The almonds were in bloom on the 12th. The walnut-trees promised well. The cherries were in bloom by the 21st, and made a promising appearance. Not so the apples, and still less the apricots and peaches.

Some hives of bees were preserved by dint of care, and by feeding them.

The nightingale was heard on the 4th,

and the cuckow the next day. The swallow appeared at the same time.

The season still continued sickly, though few died. All creatures were healthy, excepting that some dogs ran mad.

M A Y.

FROM the beginning to the end of this month the weather was cold and rainy, with frequent hail. The depth of rain that fell here (at Berne) was 6 inches $\frac{1}{4}$.

The winter corn was thin and stunted, owing to the cold and wetness of the season; though in some places it had a better appearance. The spring-corn promised well, especially on dry soils; the strong soils being chilled by the frequent rains. The rye was in ear on the 8th, and in bloom on the 20th, when the wheat was not yet in ear. The barley was in ear on the 14th.

The pastures promised but a scanty crop of grass, of which a coarse strong sort had taken much the ascendant; the finer having been checked or destroyed by the inclemency of

the weather. The up-land pastures, or those which had not been watered, promised the best.

The cold and too much rain did great damage to the vines, and made them shoot forked. Many plants of them which were thought to have been killed, began to make shoots. The small vineyards fared better than the large.

The fruit was well set, and promised plenty, though the frequent cold rains made much of it fall off the trees, and caterpillars did here and there considerable damage: above all, the fly hurt the peaches in particular. In some places, a south-wind did great damage to the apple-blossoms.

The young pigs were trained up for fattening; and during the whole month clover was cut and carried to fodder the cattle:

The cold season did great injury to the bees, insomuch that there was not one swarm this month, and we were obliged even to feed the weakest hives.

The hemp and flax were fine in some

places, though not in those where the hail had fallen.

The whooping cough was frequent in the beginning of this month; as were also coughs, hoarseness, and oppression on the breast; and the disorder on the lungs of cattle had not ceased.

J U N E.

THIS month was as variable as the preceding, the weather being for the most part cold and rainy. There were but few fair days. The depth of rain amounted to 4 inches $\frac{5}{8}$, and snow fell even on the lower mountains. The North wind prevailed in some places, and in others the West.

The winter corn continued very thin, and was full of weeds. The spring corn, on the contrary, looked pretty well. Barley began to be reaped on the 23d.

Pastures, especially the wet ones, yielded but little hay, and that could scarcely be made on account of the constant rains. The lower meadows were damaged by the over-

flowing of the rivers, which also obstructed the making of hay and getting of it in.

The cold season likewise threw the vines back very much. The dressing of the vineyards was finished with the month. Their first bloom appeared on the 14th and 15th, and it was not gone off at the end of the month, owing to the very cold season. The very high winds broke off many of their branches.

The cold and wet season continued to incommode the cows.

It was equally unfavourable to the bees, though they swarmed during the whole of this month.

The fruit fell off the trees in great quantities, and thereby disappointed our hopes of plenty. The flax and hemp were in great beauty.

Frequent aches were felt every where, and some dogs ran mad.

J U L Y.

THE weather continued very changeable, cold, and wet, during this month. The depth of rain was 6 inches $\frac{1}{2}$. The

wind generally West. The rivers overflowed in most places, and did great damage to the hay. In the night of the 10th an aurora borealis appeared, and lasted till late.

On the 10th we began to reap our winter barley, which was rather thin, but the ears were very fine. The winter and spring wheat answered pretty well; though the former was much laid by the continual rains, which likewise rendered it smutty in some places. Harvest continued from the middle to the end of this month, and in some places till pretty far in the next.

On the 8th was gathered the rape-feed, of which there was not above half a crop, owing to the coldness of the winter, and to it's bloom having been destroyed.

The lower meadows suffered exceedingly by their being in general overflowed till the end of this month, so that scarce any hay could be made on them, and the little that was made was extremely damaged. On the contrary the aftermath, especially on the higher grounds, was very good.

The season still continued unfavourable to

the vines. Their bloom did not go off till towards the middle of this month, and the grapes were few and very unequal. A few warm days at the end of the month swelled them considerably.

The flax and hemp grew very unequally, and were very full of weeds. They were both plucked about St. James's-day.

A U G U S T.

THROUGHOUT the whole of this month, the weather was extremely fair and dry. We had not any where above half an inch of rain, and the wind was generally north, which contributed much to the drying of the earth. There was thunder on the 29th, when the lightening burnt a house.

The dry season favoured the harvesting of oats, which yielded a plentiful crop. The spring wheat ran more into straw than corn, and a too sudden ripening prevented it's plumping. The wheat and messin yielded but little when threshed, and likewise at the mill.

It was not till this month that the hay in the lower meadows could be made. The grass was coarse, dirty, and rotted in many places; and the aftermaths turned out poorly, having been burnt up by the excessive drought.

The grapes were almost seen to grow in the beginning of this month; but the heat and drought stopt their progress, and burnt them up. What fruit remained fell off through the drought, and all the walnut, chesnut, and acorn kind, were stunted and looked poorly.

For want of grass and water, the cows lost all their milk.

The garden plants, all burnt up and destroyed by vermin, were truly piteous to behold.

The whooping cough was frequent among children, and dysenteries broke out in many places.

S E P T E M B E R.

THIS month continued very fair, the wind being chiefly North. Hoar-frosts appeared about the middle of the

month. On the 8th there was a suffocating south wind.

A rain which fell in the beginning of the month prepared the earth excellently well for the seed time, and rendered it much easier to plow, which had been greatly hindered by the drought. The seed sown after this rain rose very well. The whole of the rain was an inch and a quarter.

The aftermath continued poor in some places and was plentiful in others.

The grapes ripened suddenly, continued small and little in quantity, the heat having made many fall off.

The gardens and fruit continued in their perishing state.

The bees yielded little honey.

Besides the whooping cough, the small-pox seized the children, dysenteries continued here and there, and carried off more children than grown persons. Many peasants cured themselves of this last disorder, by taking an infusion of rue in milk in which some kidney suet was melted.

O C T O B E R.

THE weather continued very fine during this month. More rain fell in the first half of it, than in the last. The quantity of it, in all, was $5\frac{1}{2}$ inches. The nights became colder, and the hoar-frosts increased. The night of the 31st was remarkable for a violent storm of wind with a great fall of rain.

The seed time continued to the beginning of this month. The last sown seed came up very well. The crop of buck-wheat was but poor. There were but few potatoes on dry situations, occasioned by the drought.

A second crop of hay was cut in some places till the middle of this month. The pastures in general had recovered, and yielded plenty of food, which, in some measure, supplied the want of fodder.

The vintage began on the 13th. But very little wine was made. The apples for cyder were gathered in the beginning of this month.

The bees were in good condition, and their hives heavy.

The dysentery continued, but without blood.

N O V E M B E R.

THIS month was also dry and fair. There was little rain (only $\frac{1}{2}$ an inch,) but thick fogs. The wind generally N. and N. E.

Many springs were dried up.

The vineyards were dressed.

The corn looked well every where, though rather thin in some places.

D E C E M B E R.

THIS month was pretty cold, and the sky mostly clouded. The continued drought rendered the waters very low.—Springs which had never been known to fail, were dried up; and many mills stood still for want of a stream to turn them.

The corn made a fine appearance.

The dressing of the vineyards was continued, till a fall of snow upon the heights put an end to that work.

The failure of the springs prevented the watering of the pastures in many places : in others the abuse of that operation proved extremely prejudicial.

From the 16th to the 21st a good deal of snow fell upon the mountains ; and on the 18th the vallies were covered with it.

The bees had so little honey, that it was necessary to feed them.

T H E E N D.

The drawing of the vineyard was continued, till a hill of snow upon the highest part of the mountain appeared to the north.

The nature of the springs prevented the watering of the gardens in many places: in others the want of that operation proved extremely prejudicial.

After the 10th of the 2nd a good deal of snow fell upon the mountains, and on the 15th the 2nd was covered with it. The 15th had been a day of rain, and the 16th was a day of snow.



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